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MAY 27 1987

COMMERCIAL NEWSGATHERING FROM SPACE

A TECHNICAL MEMORANDUM

MAY 1987

CONGRESS OF THE UNITED STATES
Office of Technology Assessment
Washington, DC 20510-8025

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Foreword

The news media have begun to increase the use of satellite imagery in reporting on world events. This has led some to believe that the media will soon wish to own and operate their own remote sensing systems dedicated to newsgathering. The media have generally supported the idea of a dedicated "mediasat" because it could supply a stream of timely and critical information, peering where repressive governments or dangerous natural environments have heretofore kept the press at bay. However, the mediasat concept has also generated concern. Some U.S. policymakers believe that the media's use of this potentially intrusive technology could create national security problems, complicate U.S. foreign relations, and, perhaps, erode the average citizen's expectation of personal privacy.

In order to become more fully aware of the opportunities and risks associated with the media's use of remote sensing technology, the House Committee on Science, Space, and Technology requested the Office of Technology Assessment to examine this issue in a technical memorandum.

This technical memorandum concludes that although the technology is available to create a mediasat system, the high cost and current low demand for remotely sensed data will limit media efforts to own and operate a dedicated remote sensing satellite system. Nonetheless, government and commercial remote sensing activities will continue in this country and in other countries. These activities will provide the media with an increasing variety of sophisticated and relatively inexpensive remotely sensed images. As the media's use of such images increases, conflicts are certain to arise between the media's first amendment rights and certain U.S. national security and foreign policy interests. OTA concludes that such conflicts are ultimately manageable, but that the existence of foreign remote sensing systems (which can only be indirectly affected by U.S. laws) may require some international consultation.

OTA was assisted in the preparation of this technical memorandum by many outstanding advisors and reviewers. We express sincere appreciation to each of these indiviuals and organizations. As with all OTA reports, the content of this technical memorandum is the sole responsibility of the Office of Technology Assessment and does not necessarily represent the views of our advisors or reviewers.

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NOTE: OTA appreciates and is grateful for the valuable assistance and thoughtful critiques provided by the workshop participants. The workshop participants do not, however, necessarily approve, disapprove, or endorse this report. OTA assumes full responsibility for the report and the accuracy of its contents.

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- *Remote Sensing and the Private Sector: Issues for Discussion.* OTA-TM-ISC-20, March 1984. NTIS order #PB 84-180 777; $4.50.
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- *Civilian Space Policy and Applications.* OTA-STI-177, June 1982. NTIS order #PB 82-234 444.
- *Radiofrequency Use and Management: Impacts From the World Administration Radio Conference of 1979.* OTA-CIT-163, January 1982. NTIS order #PB 82-177 536.
- *Solar Power Satellite Systems and Issues.* OTA-E-144, August 1981. NTIS order #PB 82-108 846.

Military Space

- *Anti-Satellite Weapons, Countermeasures, and Arms Control.* OTA-ISC-281, September 1985. GPO stock #052-003-01009-7; $6.00.
- *Ballistic Missile Defense Technologies.* OTA-ISC-254, September 1985. GPO stock #052-003-01008-9; $12.00.
- *Arms Control in Space.* OTA-BP-ISC-28, May 1984. GPO stock #052-003-00952-8; $3.00.
- *Directed Energy Missile Defense in Space.* OTA-BP-ISC-26, April 1984. GPO stock #052-003-00948-0; $4.50.

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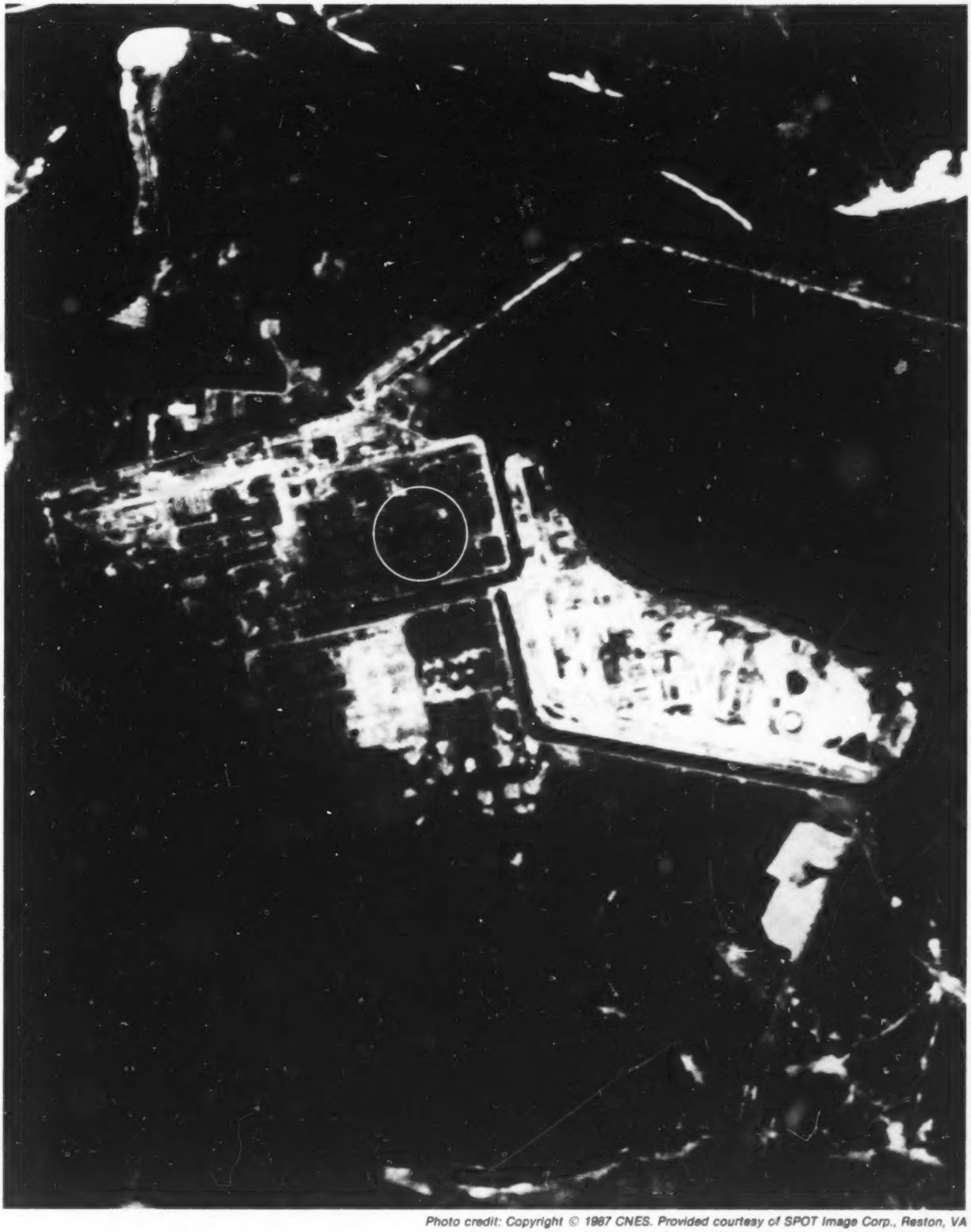


Photo credit: Copyright © 1987 CNES. Provided courtesy of SPOT Image Corp., Reston, VA

Soviet Chernobyl nuclear reactors (circled) and surrounding cooling pond. This image, taken by the SPOT satellite, combines a 20 meter multispectral image with a 10 meter panchromatic image for greater clarity. Such images allow for ongoing monitoring of the Chernobyl area.

INTRODUCTION

The U.S. news media's[1] recent use of satellite images to cover such newsworthy events as the Chernobyl nuclear disaster, the Soviet "shuttle" launch site at Tyuratam, and the progress of the Iran-Iraq war has raised the possibility that newsgathering from space could become a routine and profitable commercial activity. Some media experts have supported the concept of a mediasat[2] because it could supply a stream of timely and critical information, peering where repressive governments or dangerous natural environments have heretofore kept the press at bay.

The mediasat concept has also generated concern. Some U.S. policymakers believe that the media's use of this potentially intrusive technology could increase the visibility and risk of military operations, complicate U.S. foreign relations by angering allies and adversaries, and erode the average citizen's expectation of personal privacy.

Believing that "the use of space technologies by the media and the merging of traditional journalistic practices with long-held national space policies has not yet been satisfactorily addressed," the House Committee on Science, Space, and Technology[3] requested the Office of Technology Assessment to examine this issue. In response to the committee's request, OTA contracted for papers on remote sensing technology, the media's needs and desires, the national security implications, and the legal issues associated with newsgathering from space.[4] OTA held a workshop on December 18, 1986, to discuss these papers and to explore generally the opportunities and risks of the media's use of satellite imagery. This technical memorandum relies heavily on, but is not limited to, the information found in the contract papers and the workshop discussion.

Although the U.S. media currently make some limited use of satellite imagery, OTA is unaware of any serious planning to establish a mediasat organization. The purpose of this technical memorandum is not to examine the feasibility of a specific satellite system or business plan, but rather, to assess whether current government policy is appropriate to accommodate both current activities and future developments. Because the mediasat concept is, for the most part, undefined, OTA was forced in this technical memorandum to make a series of assumptions regarding fundamental issues such as cost, markets, technical capability, and utility of a mediasat. Although these assumptions are critical to OTA's conclusions, they are only "best guesses," based on the advice of experts in the media and in the field of remote sensing. With regard to specific issues—such as the economic viability of a mediasat or its effect on national security and foreign policy—altering these underlying assumptions could dramatically alter the conclusions reached in this technical memorandum.

---

[1] This technical memorandum uses the terms "news media" or "media" interchangeably to refer to both the electronic and the print media. The branches of the media are referred to separately only when their different needs would appear to dictate unique technology or policy choices. Except where otherwise indicated, the term media refers only to the U.S. media.

[2] "Mediasat" is not an existing satellite system or business organization. As used in this technical memorandum, the term "mediasat" refers to the concept of a satellite system and business organization that would routinely collect news and information for media use from space.

[3] Letter from The Hon. Don Fuqua, Chairman, House Committee on Science and Technology, to John H. Gibbons, Director, Office of Technology Assessment, Oct. 16, 1986; letter from The Hon. Bill Nelson, Chairman, Subcommittee on Space Science and Applications, House Committee on Science and Technology, to John H. Gibbons, Director, Office of Technology Assessment, Oct. 7, 1986. (In January 1987, the committee's name was changed to the Committee on Science, Space, and Technology.)

[4] A summary of the papers on remote sensing technology and legal issues are included in apps. A & B.

PRINCIPAL FINDINGS

Finding 1

The media's experience with satellite imagery has thus far been extremely limited. Therefore, the precise value of satellite imagery to the media is uncertain and is likely to remain so until experience and a more robust remote sensing market combine to define a stable demand for these data.

The media have used and continue to use satellite images in their news gathering activities. Whether this limited use will blossom into extensive, routine use or even a dedicated "mediasat" organization will depend on:

1. the cost of remotely sensed data;
2. the demand for, and therefore the value of, "media-quality" images to the media and to other users; and
3. U.S. and foreign government policies regarding the collection and distribution of high-quality satellite images.

Much of the current writing on the mediasat concept has stressed the desire for high resolution, timely delivery, and assured access to data. Although these demands follow logically from current newsgathering practices, they are not the product of detailed technical or economic research or of experience. It is important to recognize that, in the absence of such research or experience, the news media can have only an imprecise understanding of the value of low- and high-resolution data and the value of real-time and delayed information.

Finding 2

The current commercial remote sensing systems, the U.S. EOSAT and the French SPOT, allow the media to experiment with satellite imagery but lack the high resolution, timely delivery, and assured access to data that some media experts feel could make satellite imagery an integral part of the newsgathering process.

EOSAT (figure 1) and SPOT (figure 2) provide a relatively low-cost means by which the media could practice both using satellite imagery and working within current government policies. However, existing commercial systems do not provide "timely access" or high resolution, primarily because these capabilities are expensive and unnecessary to meet the needs of the traditional purchasers of remotely sensed data. In addition, the media's access to data cannot be assured because the remote sensing companies currently depend on ground stations owned by other countries to collect certain data. Experience gained with the current commercial systems has shown that delivery of data considered by a foreign government to be sensitive may be delayed or denied.

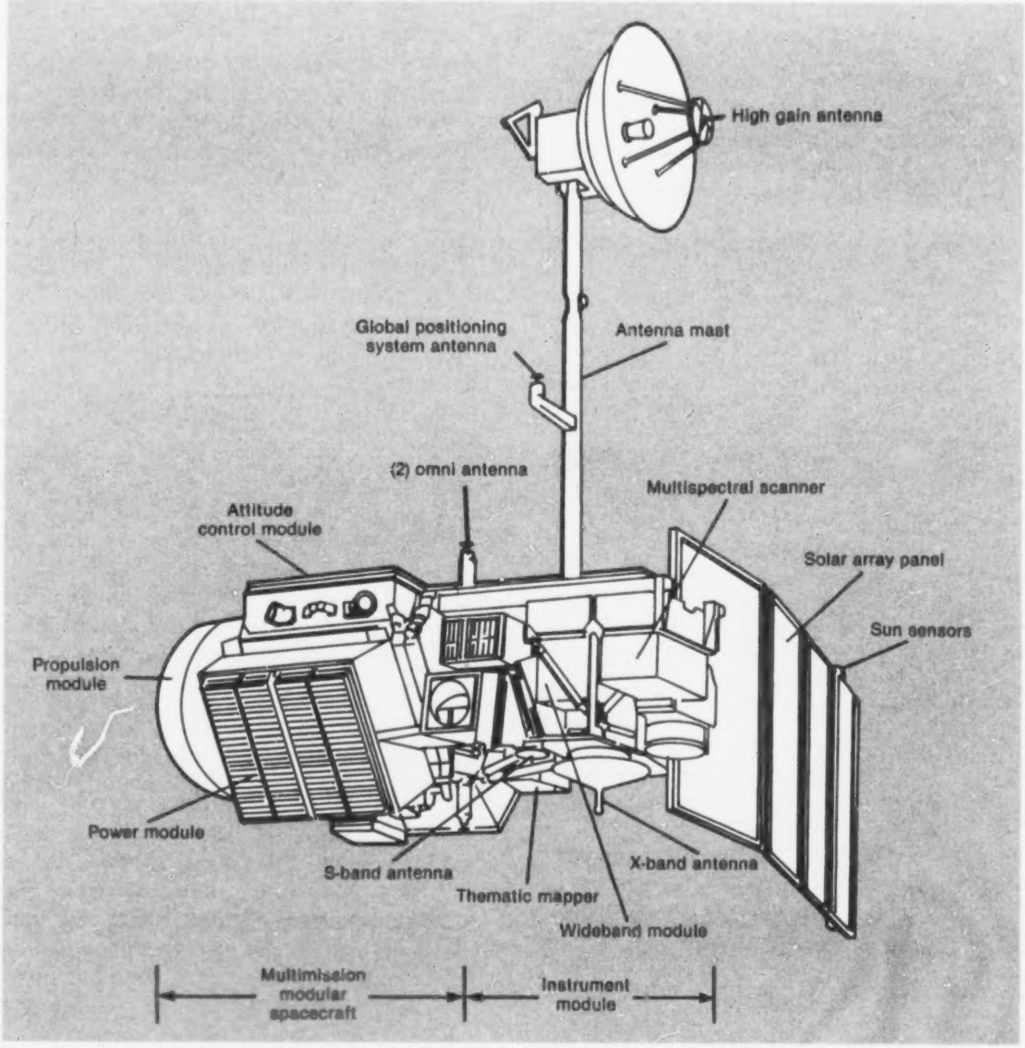
Finding 3

It is possible to build a mediasat system with high resolution, timely global coverage, and assured access to data using current technology.

Experts generally agree that costs and market uncertainties, more than technology, inhibit the establishment of a mediasat system. Media experts have identified high spatial resolution (5 meters or less) as the principal performance requirement for a mediasat. By comparison, the Thematic Mapper (TM) and the Multispectral Scanner (MSS) sensors on EOSAT's satellite provide 30 and 80 meter resolution, respectively. The French SPOT system provides 10 meter panchromatic (black and white) as well as 20 meter multi-spectral (color) imagery. Nonetheless, sensors capable of producing 5 meter images are readily available and could be flown on existing spacecraft designs.

To be effective, a mediasat needs more than high resolution; it must also be able to sense news wherever and whenever it occurs and to transmit the news rapidly to the news agency. A mediasat system would need at least two satellites to ensure same day coverage of events around the globe. In order to receive data in near-real-time, a mediasat system would need to have access to ground stations all over the earth, use on-board tape recorders, or use space-to-space communications similar to the National Aeronautics and Space Administration's (NASA) partially complete Tracking Data Relay Satellite System (TDRSS). The technology exists to obtain high-resolution, near-real-time imagery; what is lacking is the clear financial justification for employing this technology.

Figure 1.—Landsat-5 Spacecraft


High gain antenna
Global positioning system antenna
Antenna mast
(2) omni antenna
Multispectral scanner
Attitude control module
Solar array panel
Sun sensors
Propulsion module
Power module
S-band antenna
Thematic mapper
X-band antenna
Wideband module
Multimission modular spacecraft
Instrument module

SOURCE: National Oceanic and Atmospheric Administration.

MISSION: Collect remotely sensed, multispectral land data, broadcast data for receipt at ground stations operating under formal agreements

ORBIT: 705-km, sun synchronous, 16 day repeat cycle

SENSORS AND FUNCTIONS:

Multi-spectral Scanner (MSS):
Swath width is 185-km; resolution is 80-m

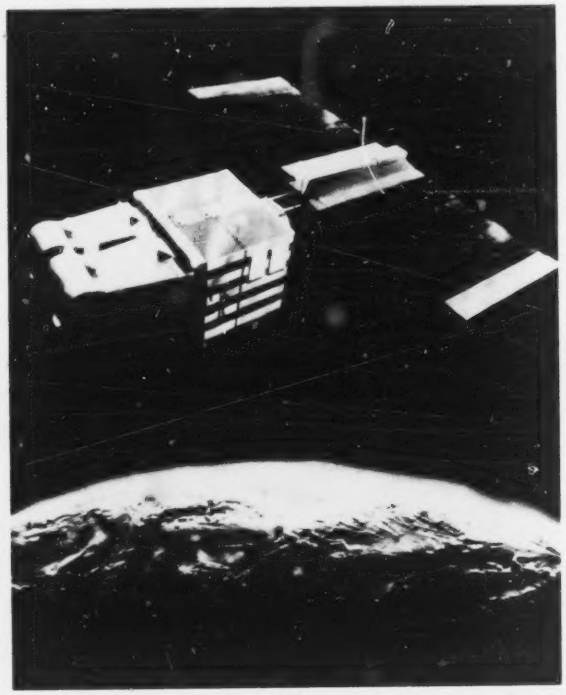
Sensor Wavelengths (μm)	Primary Uses
0.5 - 0.6	Movement of sediment laden water, delineation of shallow water areas
0.6 - 0.7	Cultural features
0.7 - 0.8	Vegetation, boundary between land and water, landforms
0.8 - 1.1	Penetration of atmospheric haze, vegetation, boundary between land and water, landforms

Thematic Mapper (TM): The TM is designed to provide 30-m resolution, except for 120-m resolution in the thermal infrared band

Sensor Wavelengths (μm)	Primary Uses
0.45 - 0.52	Coastal water mapping, soil vegetation differentiation, deciduous coniferous differentiation
0.52 - 0.60	Green reflectance by healthy vegetation
0.63 - 0.69	Chlorophyll absorption for plant species differentiation
0.76 - 0.90	Biomass surveys, water body delineation
1.55 - 1.75	Vegetation moisture measurement
10.40 - 12.50	Plant heat stress management, other thermal mapping
2.08 - 2.35	Hydrothermal mapping

DIRECT BROADCAST: Broadcasts are provided for ground stations which have entered into formal agreements covering the receipt and distribution of these data.

Figure 2.—Artist's Conception of the French SPOT Remote Sensing Satellite



SOURCE: Property of CNES, France. SPOT Image Corp.

Finding 4

Although cost and market research have yet to be done, preliminary calculations indicate that the costs of a mediasat might exceed the expected revenues of such a system.

To be financially viable, a mediasat would have to generate revenue sufficient to offset the costs of the system. Experts have estimated that a complete one or two satellite mediasat system (i.e., sensor, spacecraft, launch vehicle, data collection facilities, and image processing facilities) capable of 5 meters resolution, designed to operate about 5 years, could cost between $215 million and $470 million to establish and $10 million to $15 million a year to operate. Even if each network used satellite images every day, only a few thousand images would be used per year; hence the system's development and operating costs could only be paid back if networks were willing to pay $35,000 to $73,000 per "story," an order of magnitude more than existing expenditures for daily news coverage.

Nonetheless, should it turn out that OTA's cost estimates for a mediasat are dramatically overstated (because the technology has become more sophisticated and/or less costly) or a very high demand (from the media and other data users[5]) were to develop for satellite images, mediasat might become an economically viable concept.

Finding 5

A mediasat would probably compound problems inherent in the management of national security and foreign policy in a spirited democracy; however, such problems would likely be manageable.

Experts generally agree that the media's extensive use of high-resolution satellite imagery for newsgathering could complicate certain U.S. national security activities and certain U.S. foreign policies. Experts disagree, however, about the nature and seriousness of these "complications," and the extent to which they differ from traditional tensions between the press and the national security and foreign policy communities.

Although each is the subject of some controversy, national security experts consulted by OTA identified five areas where a mediasat could complicate U.S. national security and foreign policies. The media could:

1. disseminate information regarding U.S. military operations, thereby depriving U.S. troops of the critical element of surprise;
2. reveal information considered sensitive by foreign governments, thereby prompting them to retaliate against U.S. Government activities, assets, or personnel;
3. provide valuable intelligence to countries currently lacking their own reconnaissance satellites;
4. reveal facts about an unfolding crisis, making it more difficult for government leaders to act calmly and responsibly; and
5. misinterpret satellite data in such a way as to precipitate a crisis.

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[5] Some of the costs of a mediasat could be offset by selling data to map makers, geologists, agricultural planners, and other current users of remotely sensed data.

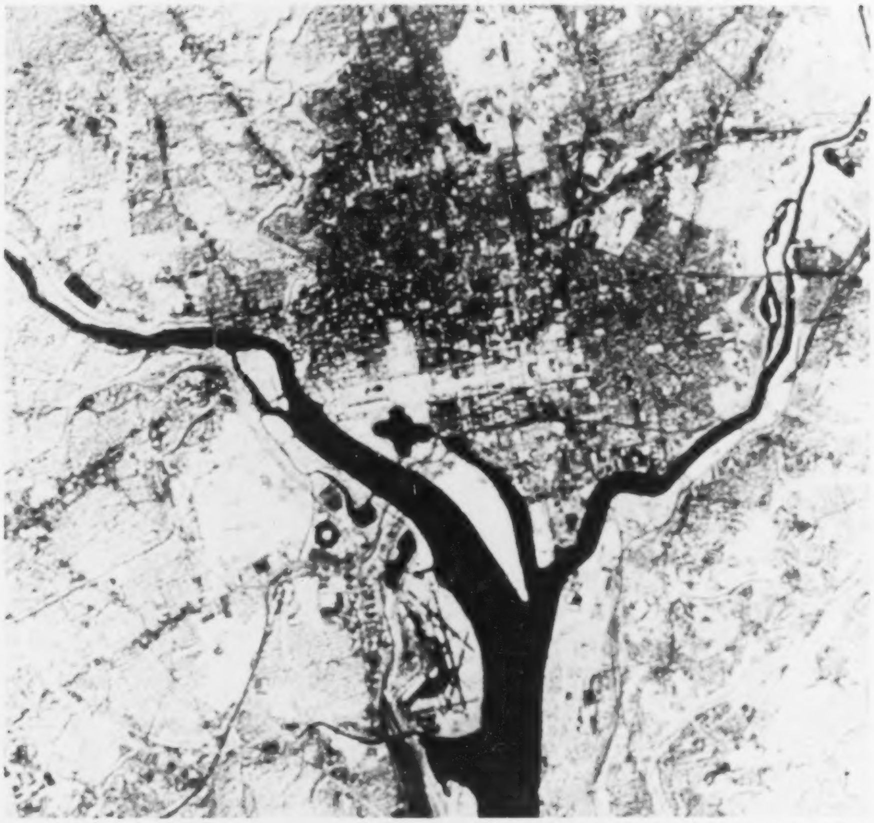

Photo credit: Copyright © 1987 EOSAT. Provided courtesy of EOSAT.

Washington, D.C., and surrounding area—Thematic Mapper band 4 is used, and illustrates major areas and buildings of the downtown area. For example, the Washington Monument, Pentagon, Capitol, and National Airport can be seen.

The most common media response to all of these allegations is that, although a mediasat could provide a substantial new source of data, the media's extensive contacts and information sources within the United States and around the world already provide the press with near-real-time information concerning fast-breaking news stories. The U.S. media are also proud of their "track record." They assert that where lives have been at stake or serious national security issues have been raised, they have cooperated with the government by withholding information until the danger or sensitivity has passed. Finally, some national security and media experts argue that granting the media access to high-resolution satellite data could have a stabilizing influence, in that nations would realize that aggressive actions would be seen and reported throughout the free world.

Finding 6

Within a decade, many nations will have their own remote sensing systems. It is unclear whether the U.S. Government could effectively limit or control media access to satellite imagery if foreign governments do not exercise similar controls.

The almost assured proliferation of sophisticated, government-owned, remote sensing systems has caused many analysts to question the practicality of attempting to regulate the media's use of satellites to gather news. Some experts maintain that since U.S. laws would not be applicable to foreign systems, U.S. news agencies could bypass U.S. restrictions by purchasing data from, or investing in, foreign remote sensing systems.

Others disagree, arguing that foreign remote sensing systems—either as a result of financial constraints, less sophisticated technology, or a country's own domestic policies—might have limited resolution. Therefore, it is possible that, with minimum intergovernmental coordination, the United States could substantially delay the time when the media would have access to very high-resolution satellite images.

Finding 7

Government attempts to limit access to or use of satellite imagery would likely result in first amendment challenges to such limitations. The outcome of these challenges would turn on the exact nature of the government limitations and the Supreme Court's ultimate determination of the status of newsgathering activities under the Constitution.

Should the U.S. Government desire to inhibit a media-owned satellite from gathering potentially sensitive information it could—either permanently, through the licensing procedures established in the 1984 Landsat Act,[6] or temporarily during a crisis —attempt to limit:

1. the resolution of the satellite's sensors;
2. the images that the satellite is allowed to collect; or
3. the images the media are allowed to disseminate.

The 1984 Landsat Act requires all remote sensing system operators to obtain a license from the Secretary of Commerce, who is charged with the duty of ensuring that applicants comply with the "international obligations and national security concerns of the United States." Some media representatives have argued that such licensing provisions should be declared invalid because they are not drafted with the narrow specificity required of statutes affecting first amendment interests. The validity of this point of view will rest heavily on the Supreme Court's ultimate determination of the status of newsgathering activities.

If newsgathering is given the degree of first amendment protection afforded traditional speaking and publishing activities, the licensing procedure established in the Landsat Act and future restrictions on mediasat activities might be regarded as impermissible "prior restraints" on free speech. The doctrine of "prior restraint" holds that advance limitations on protected speech may not be "predicated on surmise or conjecture that untoward consequences may result."[7] Prior restraints are allowable only if necessary to prevent "direct, immediate, and irreparable damage to our Nation or its people."[8] On the other hand, should the Supreme Court hold that news gathering was deserving of some lesser degree of protection than publication of information already obtained, the government would have considerably more latitude to limit mediasat activities. Restrictions on the *dissemination* of information already gathered would, of course, receive the full protection of the first amendment.

If the media do not own a satellite system, but rather rely on a commercial company such as EOSAT to provide them with data, it would be less clear whether the media could successfully argue that licensing restrictions violate their first amendment rights. Should the U.S. Government ask EOSAT to stop distributing raw data for a few days during a crisis and EOSAT agreed, the news media might have a case against EOSAT for breach of contract, but their case against the U.S. Government for infringing their first amendment rights would be less clear.

Finding 8

Should the U.S. Government wish to encourage the eventual development of a U.S. mediasat industry, it should continue its support for the U.S. Landsat system; such support would likely require sizable subsidy for a period of years.[9]

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[6] 15 U.S.C. 4201-4292

[7] Justice Brennan concurring in, *New York Times Co.* v. *United States*, 403 U.S. 713, 724 (1971).

[8] Justices Stewart and White, concurring, *New York Times Co.* v. *United States*, ibid.

[9] The funding problems and opportunities of the Landsat program and EOSAT are beyond the scope of this paper. In reaching this conclusion, OTA drew upon its previous work. See: U.S. Congress,

A mediasat industry is less likely to develop in the United States if the media must shoulder the entire cost of the "infrastructure" needed to support its occasional use of satellite images. If, on the other hand, there already existed in the United States a strong "value-added" industry—small firms expert in the interpretation and visual presentation of data—and a large pool of experienced photointerpreters, the mediasat concept would become more viable. A robust value-added industry and a cadre of experienced photointerpreters are more likely to develop if the United States has a healthy land remote sensing industry catering to diverse scientific and commercial needs.

Office of Technology Assessment, *International Cooperation and Competition in Civilian Space Activities*, OTA-ISC-239 (Washington, DC: U.S. Government Printing Office, July 1985), p. 15; U.S. Congress, Office of Technology Assessment, *Remote Sensing and the Private Sector: Issues for Discussion—A Technical Memorandum*, OTA-TM-ISC-20 (Washington, DC: U.S. Government Printing Office, March 1984).

REMOTE SENSING TECHNOLOGY AND THE MEDIA

Mediasat Described

At present, the news media obtain data from two commercial remote sensing systems, EOSAT —formerly the U.S. Government's Landsat system[10]—and SPOT, a French system.[11] Neither of these commercial systems was designed to meet the specific needs of the media and neither firm has plans to buy new satellites or alter its business structure to allow it to meet these needs. Consequently, media experts have begun to examine the feasibility and desirability of a "mediasat;" a spacecraft owned and operated—in whole or in part—by the news media and dedicated to news and information gathering activities [see box A and figures 3 and 4; box B and figure 5]. Although individual conceptions of a "mediasat" vary, as it is most often described, a mediasat would differ from the current commercial systems in three important ways:

1. *Spatial Resolution*: Spatial resolution of 5 meters or less [see box C] is often identified as the principal performance requirement for a mediasat.[12] By comparison, the TM and the MSS sensors on EOSAT's satellite yield 30 and 80 meter resolution, respectively. The French SPOT system provides 10 meter panchromatic as well as 20 meter multispectral imagery. At present, neither SPOT nor EOSAT has plans to fly sensors capable of approaching the 5 meter resolution sought by the media.[13]

Box A.—A Remote Sensing Satellite System

A remote sensing satellite system consists of four major components, each of which is critical to producing useful data:

1. *The Spacecraft, Sensors, and Transmitters*: The spacecraft provides a stabilized platform and power for the sensors and their optics, the receiving and transmitting antennas, and the associated electronics necessary to control the spacecraft and to deliver data to Earth. Some remote sensing spacecraft may also carry tape recorders to store data until the spacecraft is within sight of a receiving station.
2. *The Receiving Station and Other Communications Components*: A ground station may receive data in digital form directly from the satellite as it passes overhead, or, if the satellite is not in a position to communicate with the ground station, through a system equivalent to NASA's 3-satellite Tracking and Data Relay Satellite System (TDRSS).* In the latter case, data are passed from the remote sensing satellite to a communication satellite in geosynchronous orbit and then retransmitted to a ground facility. From the ground facility, the data are then passed directly to a processing laboratory.
3. *The Data Processing Facilities*: Before the raw data can be converted into photographic images or computer tapes capable of being analyzed by the end user, they must be processed to remove geometric and other distortions inevitably introduced by the sensors. For the purposes of newsgathering, high-speed mainframe computers may be required to process the data from current spacecraft.
4. *Interpretation of the Data*: After the raw data are processed and converted to computer tapes or photographs, they must be interpreted. Part of the interpretation process may involve merging or integrating other data either directly on the computer tape, or comparing such data with photographs. At this stage, computer analysis could be performed by micro- or mini-computer. A variety of advanced techniques (see box G) are available to turn remotely sensed data into new products for different users.

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*Only one TDRSS satellite is currently in orbit.

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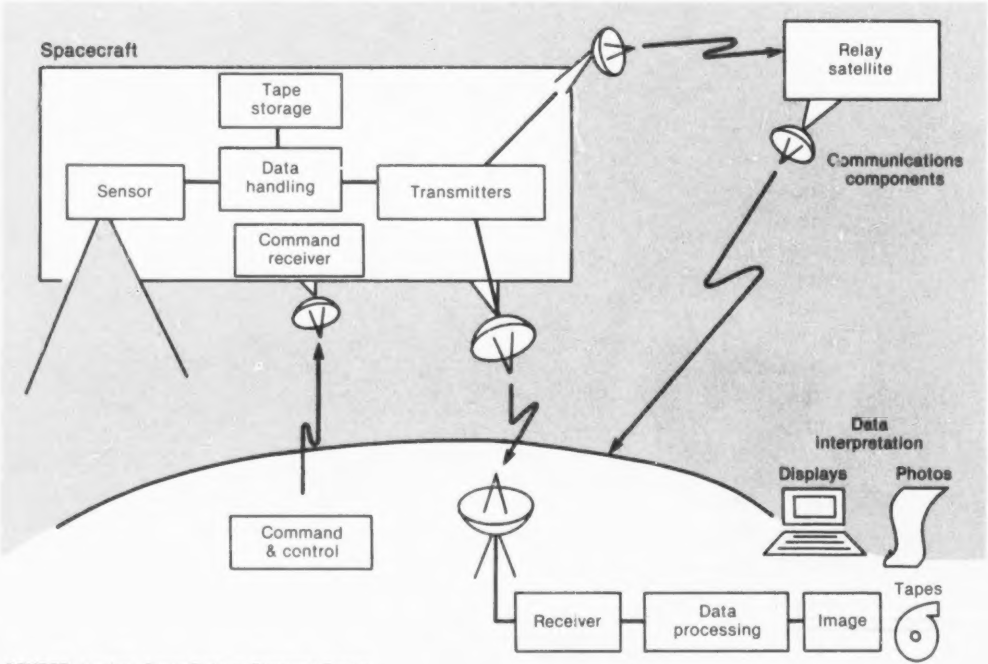
[10] For a history of the U.S. Landsat system and the details of its somewhat stormy transfer to the private sector, see: U.S. Congress, Office of Technology Assessment, *Remote Sensing and the Private Sector: Issues for Discussion—A Technical Memorandum*, OTA-TM-ISC-20 (Washington, DC: U.S. Government Printing Office, March 1984); National Research Council Space Applications Board, *Remote Sensing of the Earth From Space: A Program in Crisis* (Washington, DC: National Academy Press, 1985).

[11] The French Government controls the SPOT satellite and a private French company, Spot Image, S.A., and its American subsidiary, Spot Image, Corp., market the data.

[12] At the workshop it was clear that the media's desire for sensors allowing a resolution of 5 meters or less is not based on experience or research. The exact number is flexible and could be more accurately stated as "that degree of resolution which is better than either the SPOT or EOSAT systems but which is still affordable."

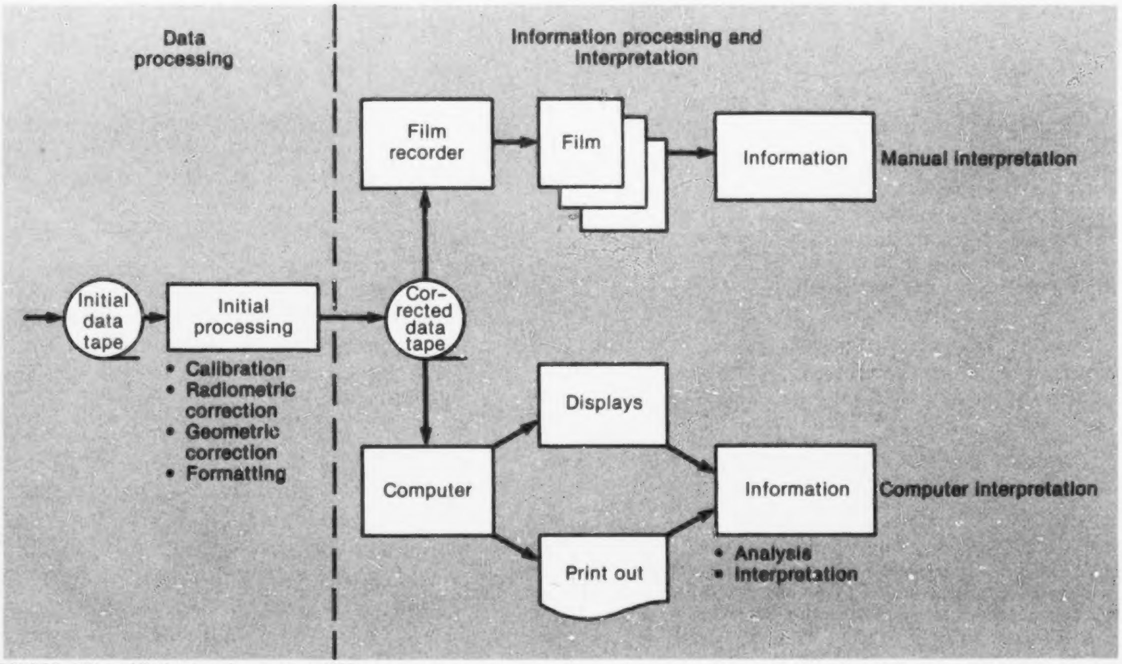
[13] It is important to note the relationship between resolution and the width of coverage (swath width). Had the French chosen a 20 km by 20 km swath width instead of their current 60 km by 60 km coverage, they would have had a resolution of 3.3 meters, assuming the same number of minimum picture elements (pixels) in their sen-

Figure 3.—A Remote Sensing System


Spacecraft
Tape storage
Data handling
Sensor
Transmitters
Command receiver
Relay satellite
Communications components
Data interpretation
Displays
Photos
Command & control
Receiver
Data processing
Image
Tapes

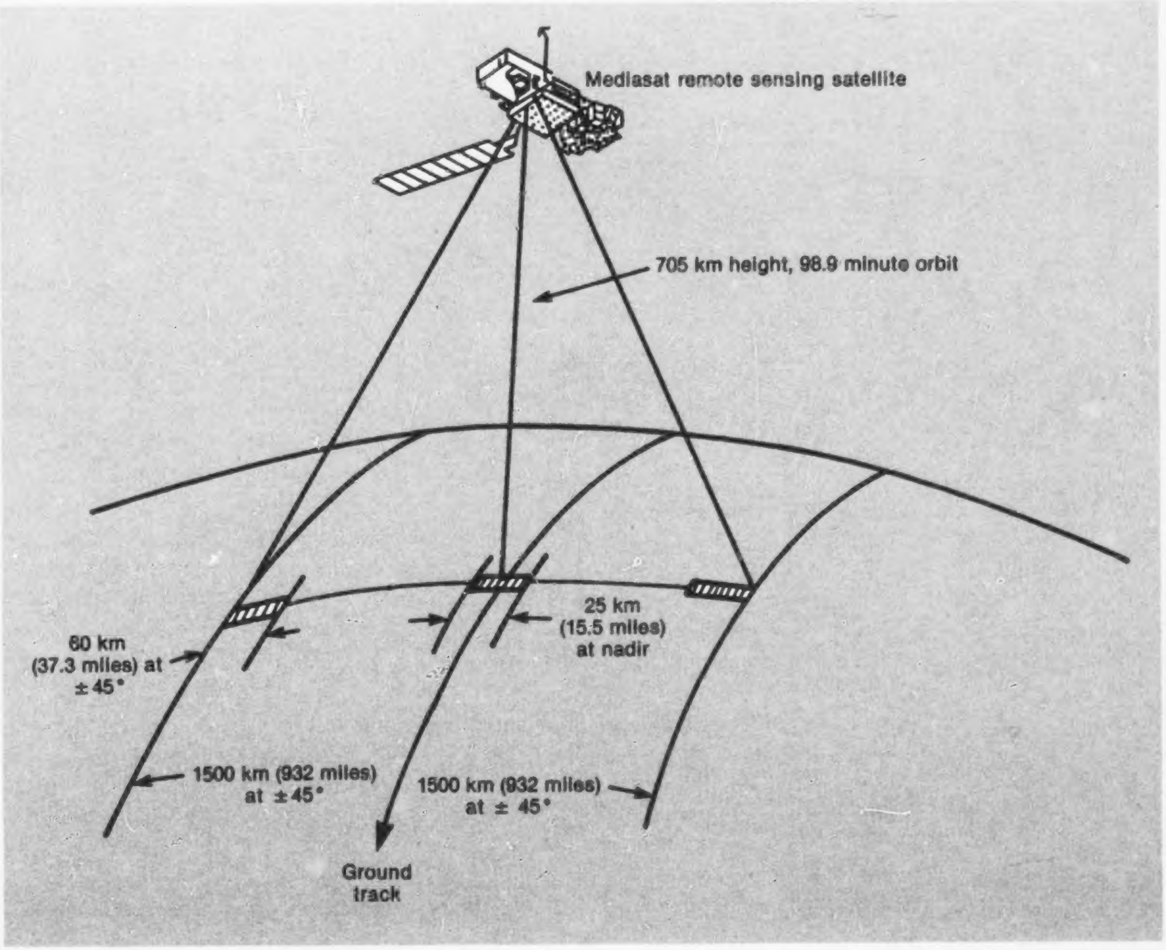
SOURCE: Hughes, Santa Barbara Research Center.

Figure 4.—Data Processing and Interpretation


Data processing
Information processing and interpretation
Film recorder
Film
Information
Manual interpretation
Initial data tape
Initial processing
• Calibration
• Radiometric correction
• Geometric correction
• Formatting
Cor-rected data tape
Displays
Computer
Information
Computer interpretation
Print out
• Analysis
• Interpretation

SOURCE: Office of Technology Assessment, 1987.

Figure 5.—Polar Orbit Provides Global Coverage


Mediasat remote sensing satellite
705 km height, 98.9 minute orbit
60 km (37.3 miles) at ± 45°
25 km (15.5 miles) at nadir
1500 km (932 miles) at ±45°
1500 km (932 miles) at ± 45°
Ground track

SOURCE: Hughes, Santa Barbara Research Center.

2. *Timely Global Coverage*: To be most effective, a mediasat would have to deliver news in a matter of hours from anywhere on the globe [see box D and figures 6-8]. Neither the satellites nor the business structures of EOSAT and SPOT are designed to produce imagery that quickly. Such timeliness would require new ground processing techniques and delivery methods and at least two satellites and supporting communication facilities to ensure that the media would have the opportunity to image every spot on Earth at least once a day.
3. *Media Control Over System and Products*: EOSAT and SPOT, although commercial systems, receive substantial financial support and guidance from their sponsoring governments and rely on the cooperation of those countries that maintain ground stations (see the following section, *National Security and Foreign Policy*). As a result, issues such as

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continued from page 8

sor array. Reducing swath width, however, would have greatly increased the time it takes to obtain global coverage with one satellite. It would also have reduced the synoptic view desired for many other uses of the data.

limitations on sensor resolution and the release of sensitive data can be strongly influenced by government policy. A successful U.S. mediasat would have to eliminate such government intervention to ensure the degree of independence the media now enjoy in their other news gathering activities.

Box B.—Why Remote Sensing Can Be Useful for Newsgathering

From the technical standpoint, remote sensing from space provides data users with several key features:

- ability to view remote, difficult, or denied terrain;
- view unaffected by political boundaries;
- synoptic view of large portions of Earth's surface;
- the possibility of near real-time data recovery;
- signals suitable for digital storage and subsequent computer manipulation into news-ready imagery;
- repetitive coverage over comparable viewing conditions;
- selected combinations of spectral bands for identifying and analyzing surface features.

In addition, data from space provide the following advantages:

- *Convenient Historical Record, Stored on Magnetic Media and Photographs*: Each image establishes a baseline that is of critical importance in recognizing the inevitable environmental and other changes that occur over time.
- *Tool for Inventory and Assessment*: Satellite images could be used whenever a major natural or technological disaster strikes an area and massive breakdowns of communication, transportation, public safety, and health facilities, prevent the use of normal means of inventory and assessment.
- *Predictive Tool*: Properly interpreted imagery can be used to predict the onset of natural and technological disasters.
- *Planning and Management Tool*: Imagery can be used for a variety of planning and management purposes.

SOURCE: Office of Technology Assessment, 1987.

The Media and the Uncertain Value of Satellite Imagery

During the course of the OTA workshop, it became clear that with the exception of certain trade publications and the magazine *Aviation Week and Space Technology*, the media's experience with satellite imagery—excluding weather satellite imagery—has been extremely limited (table 1). As a result, the media—especially the major television networks—have no clear idea of the type of imagery they want, how much they might need, or how much they are willing to pay. In short, the value of satellite imagery to the media is, at present, uncertain and is likely to remain so until experience and a more robust remote sensing market combine to define a stable market for these data.[14]

Fundamental to this issue of uncertainty are questions concerning the type and quality of data needed by the media. Several of the media representatives at the OTA workshop brought examples of how SPOT and EOSAT data have been used in recent news broadcasts. After viewing several such news stories, one workshop participant commented that,

> The pictures themselves are unremarkable . . . most of these pictures are essentially illustrations of a story that you have to make up.

This comment goes to the heart of the media's problem—does it need images that the viewer can identify and interpret, or is there value in images that, although not identifiable by the viewer, hold important information when interpreted by an expert? One panelist noted,

> It is important to distinguish between information that has to be interpreted and . . . material the viewers at home . . . could draw their own conclusions from. There is obviously much more value in material that does not require interpretation.

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[14] It is interesting to note, however, that the media's use of remote sensing imagery has increased substantially since the launch of the higher resolution SPOT satellite. This suggests that at even higher resolutions, such as 5 meters, there could be another substantial increase in the demand for satellite imagery.

Box C.—Spatial Resolution and Spectral Resolution

Spatial resolution refers to the ability of an optical device, such as the sensor of a remote sensing spacecraft, to separate objects of a given size. An instrument of high resolving power can separate two small objects very close together, or resolve the image of relatively small features on a larger object. For example, a spatial resolution of 1 meter (approximately 39 inches) could allow a viewer to distinguish between an automobile and a bus, but such resolution might not allow one to distinguish between an automobile and a pickup truck.

The best resolution available on images formed by civilian remote sensing satellites is the 10-meter resolution offered by the sensors and optical systems on the French SPOT satellite.* Such resolution allows one to see individual buildings and streets in a city landscape. It also permits one to pick out semi-trailer trucks on the streets or ships at a dock. It would generally not make it possible for the viewer to distinguish between the image of two semi-trailer trucks parked side by side and a building of similar dimensions, because the images of the two trucks would merge.

Overall resolution is limited by the resolving power of the sensor's individual picture elements. The minimum picture element, or pixel, of SPOT data, for example, corresponds to 10 meters (approximately 33 feet) on the ground. No amount of simple magnification of the remotely-sensed image will improve the resolution beyond this minimum pixel size. For an object with dimensions less than 10 meters, the sensor will effectively spread out the light emanating from such an object so that it is impossible to determine the position of the object within the 10 meter pixel. Structural details of the object will also be spread out in a similar manner.

However, knowledge of the general terrain, the detailed characteristics of particular objects, and experience in photointerpretation, can vastly improve an interpreter's ability to understand the details of an image. In addition, sophisticated and costly computer processing can improve on the theoretical resolution of an image by as much as a factor of 2.**

Although the *spatial resolution* of a sensor provides a general guide to its ability to "see" objects on the ground, photointerpreters are also concerned with *spectral resolution*. Since all objects reflect light differently, an object's color or its contrast with the background environment can also be used to distinguish it. For example, the Great Wall of China is wide enough to be detected on Landsat TM images (resolution of 30 meters, or 98 feet). However, because the wall is nearly the same color as the surrounding countryside, it is extremely difficult to pick out in certain Landsat spectral bands. On the other hand, it is often possible to see a bridge or roadway of less than 30 meters wide when their contrast with the surrounding water or earth is extremely high. In effect, the bridge or road tends to "fill" each pixel with its reflected light, and because there are many such pixels spread out in a line across the scene, the eye links them together. Because objects that appear to have similar color characteristics as seen by the naked eye reflect light somewhat differently in different parts of the spectrum, it is often possible to distinguish objects on the image by subtracting the different color bands from one another. In this way, a field of corn can be distinguished from a field of soybeans, even though the sensors are incapable of resolving individual plants.

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*Early in their program, France considered building a system of higher resolution that could be used by both civilian and military data users. However, because of high costs and other priorities for research and development funds, it deferred such a program.

**See John A. Adams, "Counting the Weapons," *IEEE Spectrum*, July 1986, pp. 46-56, for a general discussion of spectral and spatial resolution.

Box D.—The Challenge of Timely Global Coverage

The Landsat satellite travels in a near-polar orbit at a distance of 706 kilometers and circles the Earth every 98.9 minutes. The SPOT satellite flies in a similar orbit, 832 kilometers above Earth, with an orbital period of 101.5 minutes. Because Earth is spinning, as a satellite travels from pole to pole, it flies over a different part of Earth on each orbit. Each of the two Landsat spacecraft, for example, passes over the same portion of Earth at the Equator once every 16 days. (Near the poles, the "footprint" of its sensors overlap in successive orbital passes, covering the same portion of Earth in as few as 8 days.) SPOT repeats its orbit only once every 26 days. However, because the SPOT sensors can be pointed to the side (off-nadir), their ability to sense a particular area on Earth in successive passes is substantially increased. The SPOT sensors can revisit a site 7 days out of 26. The ability to point its sensors also allows the SPOT satellite to take quasi-stereo images.

For the purposes of a mediasat capable of providing daily coverage of the Earth, it is necessary to have several identical satellites with pointable sensors to ensure that one is always in position to see the area of interest.

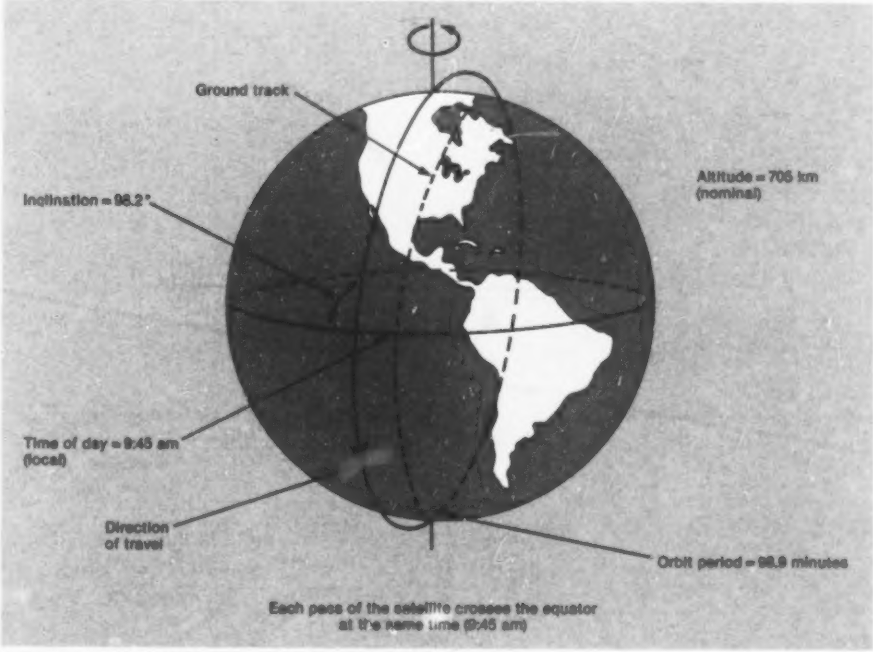
Delivering the data collected to Earth for processing is an important part of the overall process of land remote sensing. Because the satellite orbits the Earth, for some part of every orbit it will not be within "sight" of national ground stations. A satellite system must have one or more of the following capabilities:

1. tape recorders to store data until they can be played back as the satellite passes over a ground station,
2. space-to-space communications such as NASA's Tracking and Data Relay Satellites (TDRSS) to pass the information around the globe and then to Earth, or
3. ground stations in many foreign countries to ensure that data collected over other countries are eventually passed back to national territory.

None of these alternatives is without difficulty: high-capacity space-rated tape recorders have a high failure rate, historically, and are still not regarded as reliable; TDRSS cannot yet provide worldwide coverage (the second of three critical satellites was destroyed along with the Shuttle Challenger in January 1986), it is expensive to use, and commercial users currently receive very low priority; finally, receiving data from foreign ground stations can be slow and subject to political interference.

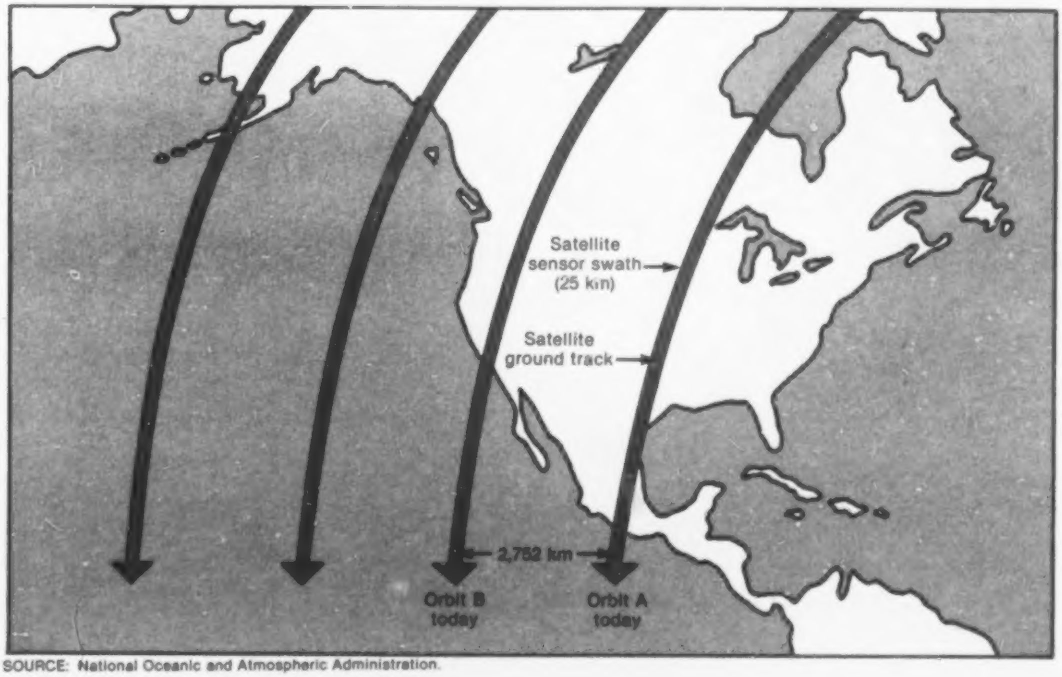
One of the most substantial impediments to timely delivery of imagery is the effects of clouds. On any one day, substantial portions of the Earth's surface are covered by clouds. Some areas can be obscured for weeks or even months at a time. Other areas are difficult to see even in "clear" weather as a result of smog or other obscuring atmospheric problems.

Figure 6.—The Orbital Path of Remote Sensing Satellite is Sun Synchronous


Ground track
Inclination = 98.2°
Altitude = 705 km
(nominal)
Time of day = 9:45 am
(local)
Direction
of travel
Orbit period = 98.9 minutes
Each pass of the satellite crosses the equator
at the same time (9:45 am)

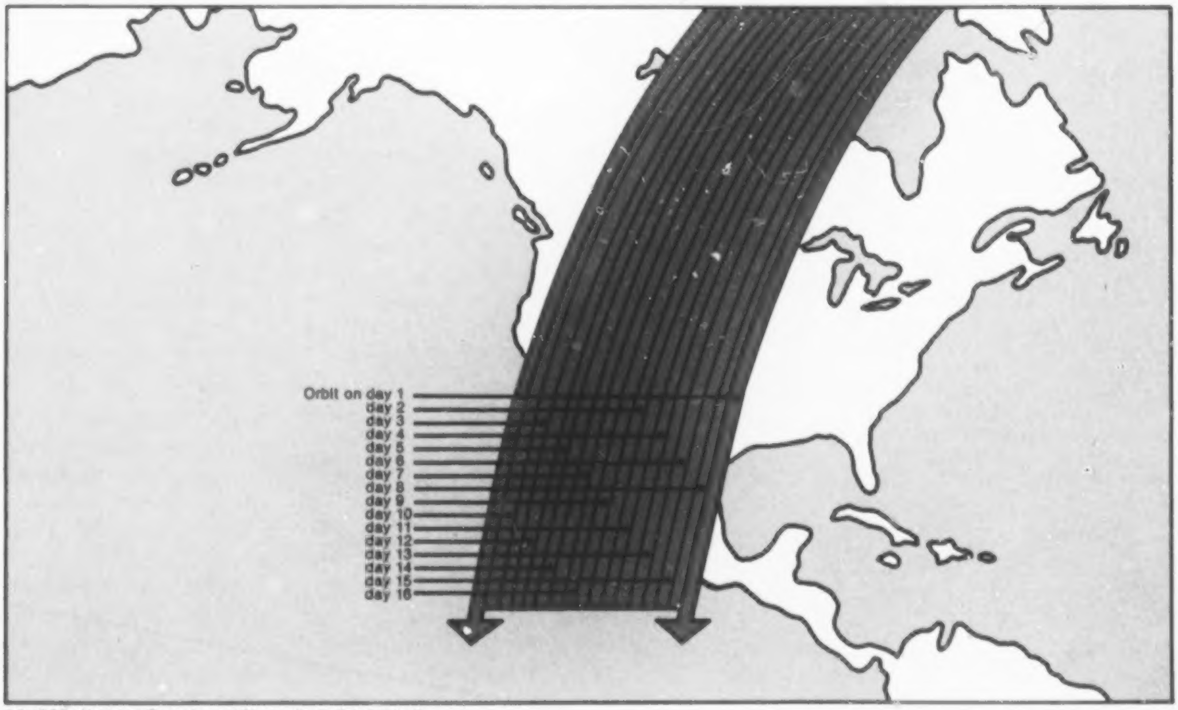
SOURCE: National Oceanic and Atmospheric Administration.

Figure 7.—The Earth Revolves 2,752 km to the East (at the equator) Between Passes


Satellite
sensor swath
(25 km)
Satellite
ground track
2,752 km
Orbit B
today
Orbit A
today

SOURCE: National Oceanic and Atmospheric Administration.

Figure 8.—Adjacent Swaths (moving westward) Are Imaged 7 Days Apart



SOURCE: National Oceanic and Atmospheric Administration.

Table 1.—Some Recent Uses of Remotely Sensed Images by the Press[a]

Date	Event
Television news	
April 1985	Iran/Iraq border area—ABC.
Janauary 1986	Libyan military airfield and SA-5 sites—ABC.
February 1986	Naval facility at Murmansk—ABC.
April 1986	Chernobyl nuclear plant—all networks.
July 1986	New York City harbor—ABC.
July 1986	Soviet nuclear testing facility at Semipalatinsk some 1800 miles southeast of Moscow—ABC, CBS, CNN.
August 1986	Soviet shuttle facility at Tyuratam in central USSR—ABC.
October 1986	Soviet Submarine base at Gremikha—Swedish television.
January 1987	Iran/Iraq war—ABC.
April 1987	Soviet radar facility near Krasnoyarsk—ABC.
Newspapers, magazines	
March 1986	Libyan SA-5 sites and military bases—*New York Post*
April, May 1986	Chernobyl nuclear plant—many newspapers, magazines
September 1986	U.S.S.R. Kola Peninsula—*Jane's Defense Weekly*
October 1986	Soviet cosmodromes at Plesetsk and Baikonur—*National Geographic*.
March 1987	Soviet Navy base at Murmansk and Soviet Air Force base at Severomorsk—*Aviation Week and Space Technology*.[b]
March 1987	Pakistani nuclear processing facility—*London Sunday Observer*

[a] These citations are representative only. The news media have put remote sensing data to many other uses.

[b] *Aviation Week and Space Technology* pioneered the use of remotely sensed images from space. Since 1974, the journal has published more than 22 major news stories based on remotely sensed images.

SOURCE: Office of Technology Assessment, 1987.

Other panelists generally agreed with this comment and emphasized that material requiring interpretation is similar to a "source story;" that is, a story based on inside or expert information but lacking images to allow the viewer to draw his or her own conclusions. Although useful in the print media, "source stories" have a more limited value in television news where the viewer expects the picture to tell the story [see box E].[15]

One panelist commented that the media "clearly had a lot of homework to do," but that this learning process could proceed in stages. First, he suggested that the media should gain as much experience as possible working with current satellite images and within current government policies. This would allow the media to define the kinds of news stories that would gain from "eye in space" graphics every day. Second, the news media should test the ability of SPOT, EOSAT, or some other source of data to meet their needs. Third, examine the attitudes of readers and viewers toward the use of these new graphic displays to reach some conclusions regarding the comparative values of high- and low-resolution data. Finally, when they had gained sufficient experience regarding both the value of current imagery and the cost and future demand for high-resolution

Box E.—Remotely Sensed Data and News Presentation

Remote sensing will open up a variety of options to illustrate stories in different ways and in different media. In particular, the news media will likely use satellite images to provide background information for stories and to illustrate the story directly. To elucidate this difference, imagine using images gathered from space to support a story that a country is amassing aircraft and other materiel on its border, possibly in preparation for invading its neighbor. Three broad levels of resolution capacity lead to different categories of stories:

1. *Story Requiring Extensive Analysis of the Image:* If the news media had access to images of 30 meter resolution, they could run a story showing a somewhat grainy image of runways and an amorphous mass of bright spots that, in the opinion of an expert photointerpreter, represent a buildup of aircraft. By carefully examining the images, the photointerpreter might be able to offer some judgments about the categories of aircraft and other objects reflected in the image. In such a case, however, the images convey little or no information to the untutored viewer, because from the image alone, he or she can make no independent confirmation of the expert's judgment.
2. *Mixed Story:* At 10 meter resolution, the image of the runway would appear much sharper and might even reveal navigation markings. In addition, large aircraft, such as cargo planes, would be readily identifiable as aircraft to the lay viewer, once the newscaster had drawn the viewer's attention to them. Smaller aircraft, such as fighters, would still appear as amorphous shapes to the uniformed observer. To be understood by the viewer, such an image would still require the analytical judgment of a photointerpreter.
3. *Story Allowing the Viewers To Draw Their Own Conclusions About the Images:* If, however, a mediasat existed with a resolution of much better than 5 meter, the evening newscast might be able to show a variety of aircraft on the runway, and perhaps even large objects being unloaded from cargo planes. In such a case, the image itself might carry most of the story, because viewers would be able to recognize that it contained many aircraft of different sizes and could draw their own conclusions about the country's intentions, especially as the media's audience becomes more sophisticated about viewing imagery from space.

In all three cases, photos or drawings of the various types of aircraft exist, and these could be shown on a split screen, with a news reporter or expert analyst pointing to relevant details.

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[15] One panelist felt that the attention given to the issue of "source stories" was unwarranted. He maintained, "Those of us who have lived through the technological developments that have affected the media over the last ten or twenty years would never attempt to neatly categorize the potential uses of remote sensing. Experience tells us that every time a significant technological advance has been made, its early planned uses either became secondary or were lost in the huge quantity of additional applications that developed once experience had been gained. Remote sending will simply open up a variety of options to illustrate all sorts of stories in different ways and in different media."

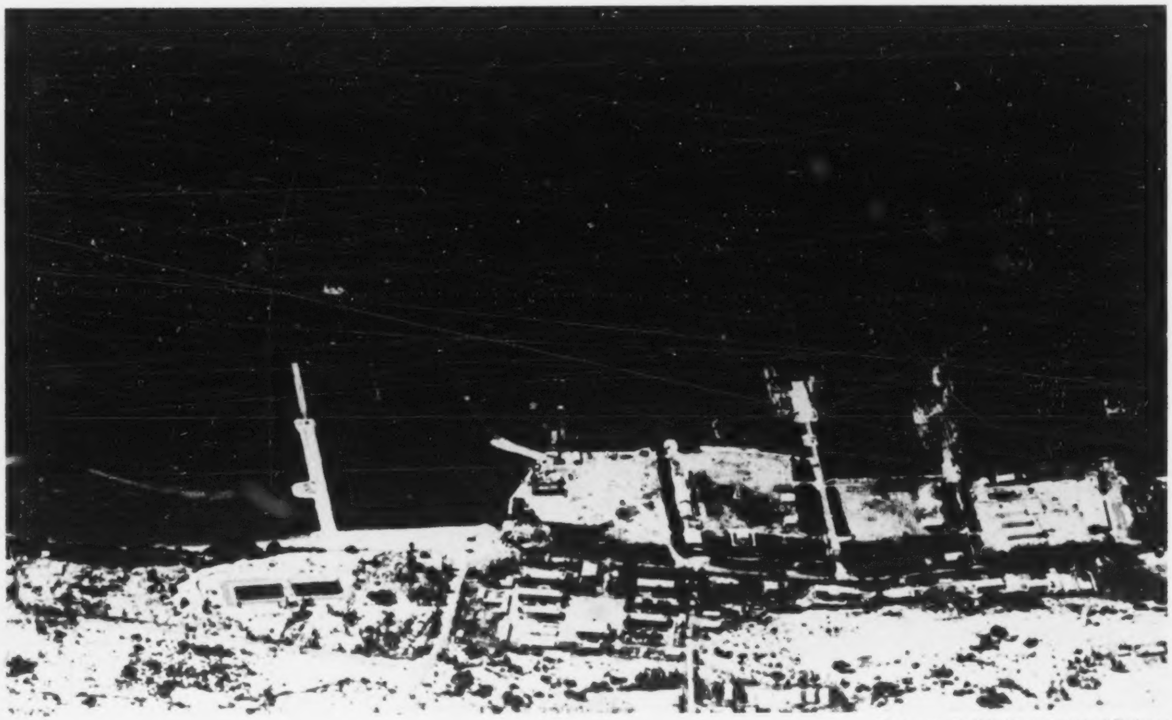

Photo credit: U.S. Department of Defense

Cam Ranh Bay, Vietnam port facility. Combatants shown in this image are the Foxtrot diesel-powered attack submarine, the Echo nuclear-powered cruise missile attack submarine, the Kashin destroyer, and the Grisha frigate. Photo resolution estimated to be about 1 meter.

imagery, the media could then make an informed judgment regarding the practicality of pursuing the mediasat concept.

The media's difficulty in assessing the value of satellite imagery is reminiscent of problems encountered by scientists in the 1970s when they first began to experiment with the Landsat data. Many experts believed then that with a little experience and a little government support, remote sensing could become a thriving commercial industry. It is instructive to note that, after nearly 15 years of experimentation, the overall market for remotely sensed data is still weak. This is true even for applications such as minerals exploration, forestry, and agriculture, where the history of experimentation demonstrates that remote sensing from space is cost effective compared to other means of gathering similar information.[16]

Alternatives for the Media

The media have at least two choices should they decide to increase the use of satellite imagery in their news coverage:

1. they could continue to use the images provided by the current commercial systems; or
2. they could fly their own satellite or a sensor on a host satellite.

Although these choices are not mutually exclusive they vary drastically in cost and complexity.

Use of EOSAT and SPOT Images

Several panelists bluntly stated their belief that the concept of a media-owned satellite system was "just not economical" today, and that, "The best way to go is to get the [EOSATs and SPOTs] of the world to supply the data that the media need." Although certainly the simplest and most economical path for the media to follow, the current com-

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[16] See: *Remote Sensing and the Private Sector: Issues for Discussion*, op. cit., ch. 4, for a discussion of the developmet of the market for remotely sensed data.

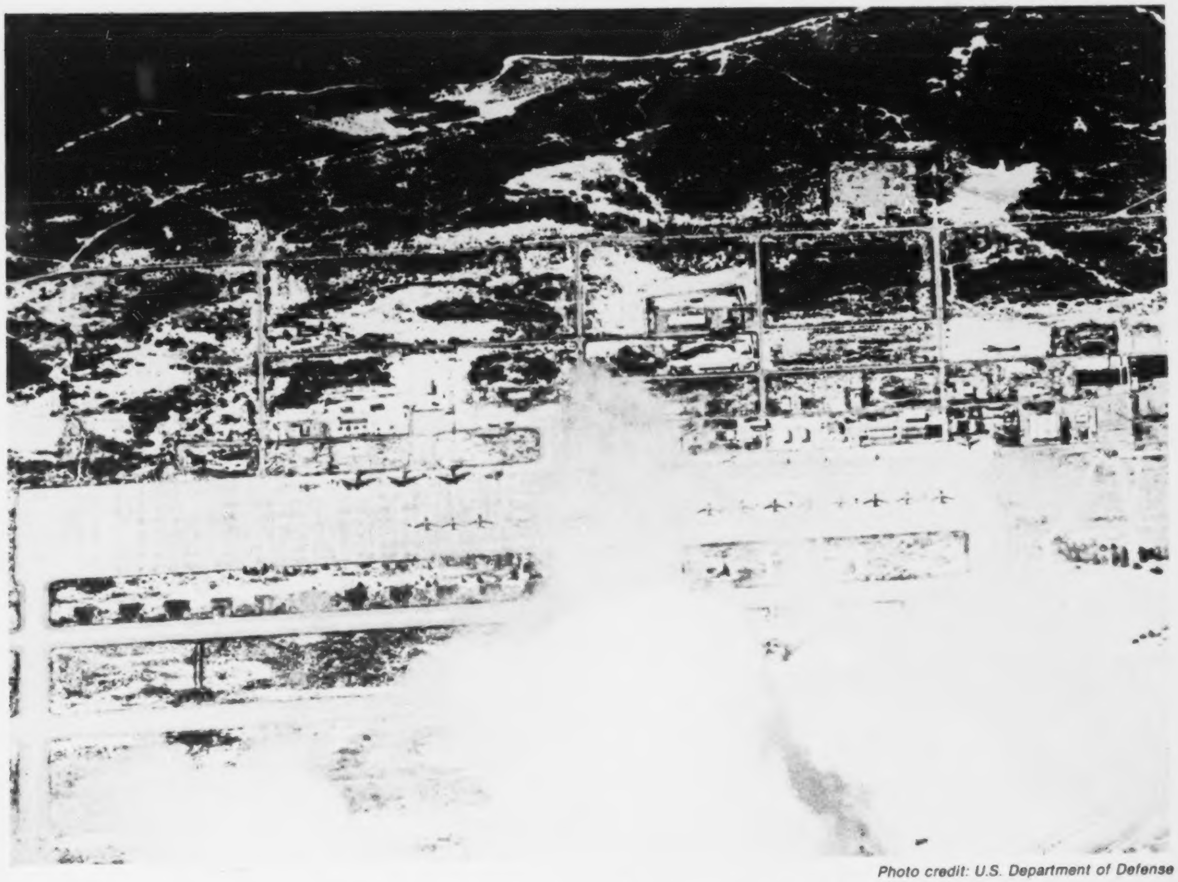

Photo credit: U.S. Department of Defense

Cam Ranh Bay, Vietnam airfield. This photo, taken from an aircraft, was released Feb. 9, 1987, by the Department of Defense to refute Soviet and Vietnamese denials of the existence of Soviet forward-deployment bases in Vietnam. Shown in this image are Soviet TU-95 Bear aircraft, TU-16 Badgers, and Mig-23 Flogger aircraft. Photo resolution estimated to be about 1 meter.

mercial systems cannot provide timely access to data, assured access to data, and high resolution [see box F].

The workshop discussed two aspects of the timeliness issue: 1) the problem of getting the data from the satellite to the media user; and 2) the need for the human resources to interpret the data.[17] On the subject of timely access to data, one panelist pointed out that neither SPOT nor EOSAT is designed to meet the particular needs of the news media. The Landsat system, now operated by EOSAT, had been a government-designed research system that was never expected to deliver data rapidly. "If you call today and ask for a scene from last year, EOSAT may be able to get it to you within a week if it's already been processed," the panelist commented, but "if it's unprocessed it takes 4 to 5 weeks." The panelist pointed out that EOSAT had been able to provide the Chernobyl images in 24 hours only because it was lucky enough to have a satellite in position and it had been willing to suspend all its other activities. Most

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[17] Both of these problems were illustrated by one newsman's experience in trying to obtain and use the satellite images of Chernobyl. He recalled: "I remember working the phones all day trying to get the Chernobyl images and finally at three in the afternoon they arrived and everyone was excited and we looked at the images and said, 'what the hell are we looking at?' So I called up EarthSat, the image processing company, and I said, 'Hey, can you send somebody down and help us interpret this stuff?' He said, 'Well, we can do it next week.' You know they're used to dealing with geologists. I said, 'Next week? I'll send a helicopter this afternoon.' "

Box F.—The Status of Land Remote Sensing in the United States

The value of viewing Earth from space to provide crucial resource and environmental information on the atmosphere, oceans, and land masses was recognized early in this Nation's development of space technology. Two years after the National Aeronautics and Space Act of 1958 was signed, the United States received its first images from space, taken by the polar-orbiting weather satellite called the Television and Infrared Observation Satellite (TIROS).

Today the TIROS satellites, and their geostationary cousins, the Geostationary Orbiting Environmental Satellites (GOES) continually monitor weather systems within their field of view. Originally developed by NASA, both systems have been operated by the National Oceanic and Atmospheric Administration (NOAA) since 1970.

NASA designed and built the Landsat system in the early 1970s. Landsat 1 (originally called the Earth Resources Technology Satellite) was launched in 1972, followed by Landsat 2 and 3 in 1975 and 1978. All three satellites carried a multispectral scanner (MSS) capable of a spatial resolution of 80 meters in four spectral bands. The output of this sensor, transmitted to Earth, then corrected and stored, constitutes the primary archival library of Landsat data, extending back to 1972. Landsat 4, which NASA launched in 1982, carries both the MSS sensor and the more powerful Thematic Mapper (TM), capable of 30 meters resolution in 6 spectral bands, and 120 meters resolution in the near infrared. An identical Landsat 5 was launched in 1984, after Landsat 4 began to experience technical difficulties. Both satellites still provide both MSS and TM data, although Landsat 4 is limited in the amount of TM data it can transmit.

In the late 1970s, believing that the development of land remote sensing would fare better in the private sector, the Carter administration began to plan for the eventual transfer of the Landsat system to private ownership. The first stage in that process was to transfer the control over the system to NOAA.[*] Transfer to NOAA was completed in 1984. The Reagan Administration decided early in its tenure to hasten the process of transfer to the private sector. In January 1984, the Department of Commerce released a request for proposal (RFP) designed to solicit offers from private industry to own and operate the Landsat and any follow-on civilian remote sensing system.

Concurrently, Congress began to develop legislation to promote the transfer to private ownership and operation. The goal of both efforts was to assist the private sector in developing a self-sustaining, commercial land remote sensing enterprise. The Land Remote-Sensing Commercialization Act of 1984 was signed into law on July 17, 1984.

In October 1984, after examining a total of seven RFPs, the Department of Commerce accepted the proposal of EOSAT, a new company formed by RCA and Hughes Aircraft Corp. However, EOSAT and the Department of Commerce had difficulty reaching agreement on the terms of the subsidy. After considerable discussion, involving the Office of Management and Budget, the Department of Commerce, and Congress, the principals agreed on a government subsidy of $250 million for two follow-on Landsat satellites. The government agreed to launch Landsat 6 and 7 on the shuttle. In addition, the government also contracted with EOSAT (for a fee) to operate Landsat 4 and 5 and to market the resulting data. However, although Congress has generally supported the subsidy, the Reagan Administration has proved reluctant to complete the subsidy payments to EOSAT, believing that the private sector should shoulder a greater share of the burden of providing the data. Neither the 1987 nor the 1988 proposed budgets contained funding for the subsidy. EOSAT recently submitted a new proposal and a new budget to the Department of Commerce, which calls for a cost increase of nearly $50 million. In addition, space transportation costs will certainly be greater than earlier envisioned.

Some Members of Congress have expressed concern that the United States will lose its leadership in remote sensing from space if the civilian program is allowed to die for lack of funding. However, as of May 1, 1987, the issue of funding for Landsat 6 and 7 had not been resolved. The lack of a U.S. civilian system and the attendent value-added industry could seriously inhibit efforts by the U.S. media to make serious use of data taken from space for newsgathering and analysis.

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[*] For a more detailed account of the early steps taken to transfer the Landsat system, see U.S.Congress, OTA, *Remote Sensing and the Private Sector: Issues for Discussion—A Technical Memorandum*, OTA-TM-ISC-20 (Washington, DC: U.S. Government Printing Office, March 1984), pp. 20-23.

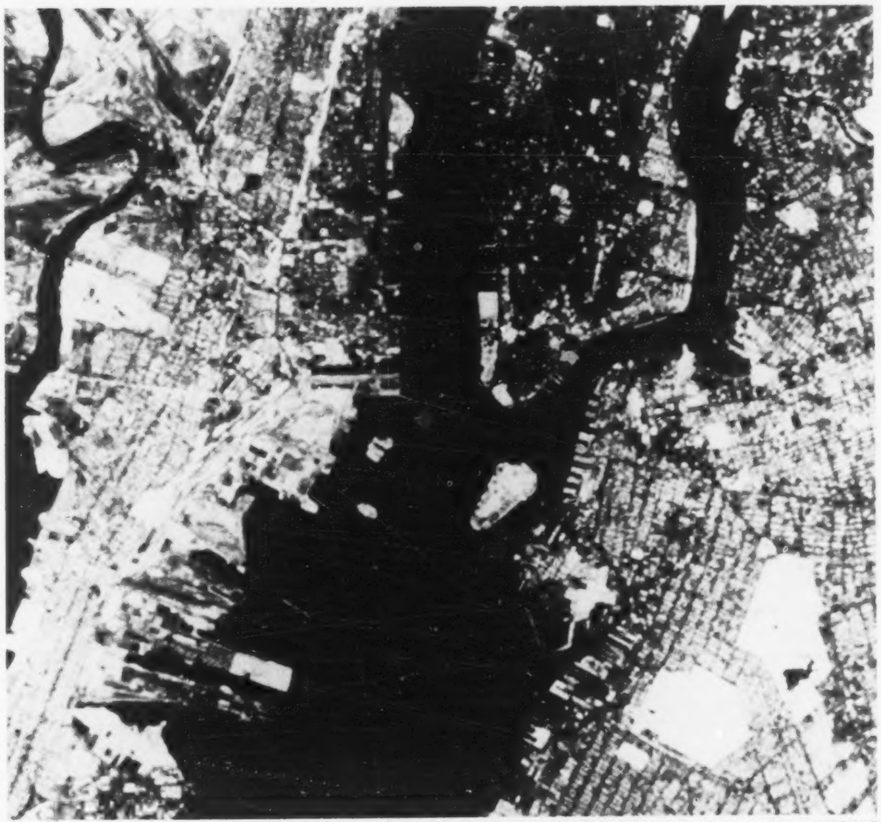

Photo credit: Copyright © 1987 EOSAT. Provided courtesy of EOSAT

New York City and Harbor, 1986. This image utilizes Thematic Mapper band 4 to differentiate urban and rural features of the City and Harbor. The detail of the 30 meter sensor allows clear definition of roadways, docks and ships in the Harbor, and the infrared illustrates parks and grassy areas in brighter shades, as opposed to the dark areas of urban New York downtown.

panelists felt that neither of these conditions would be repeated very often.[18]

Should the media decide that, even with their limitations, SPOT and EOSAT data were still valuable, they might negotiate special agreements for receiving raw data on a rapid basis and undertake the expense of doing their own ground processing and interpretation. One panelist estimated that a fully operational ground receiving and processing facility might cost on the order of $10 million to $15 million. Even if the media invested in their own ground processing facilities, they would still not have solved the problems caused by the limited global coverage and resolution of current satellites.

There was considerable disagreement at the workshop regarding the press' ability to interpret satellite imagery correctly. One panelist stated that the media had done a poor job of covering Chernobyl and contributed to the general hysteria by announcing that two reactors were on fire instead of one. The panelist argued that any competent analyst looking at the images would have recognized that:

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[18] It is useful to note that most of EOSAT's Thematic Mapper tapes have never even been processed to image format. The rate of data collection (100 scenes per day) far exceeds the rate of scene processing (20 scenes per day).

EOSAT's future business plans do include improvements that would allow a turn around time from acquisition to finished product of only one week. Although this is a substantial improvement, for most news stories, a delay of one week would probably be unacceptable.

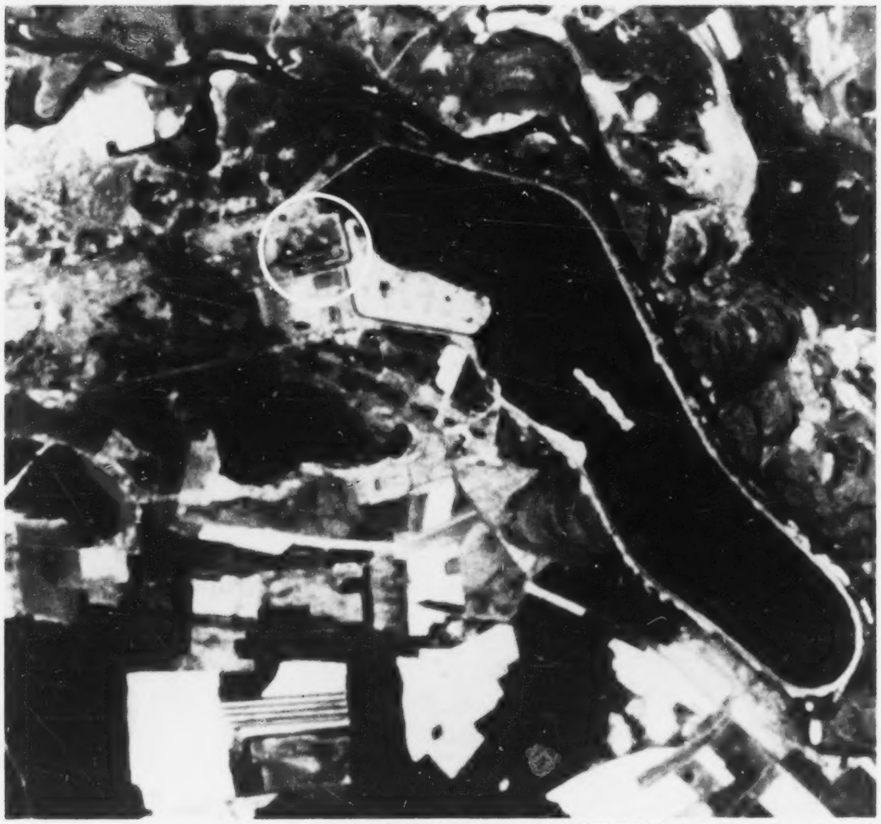

Photo credit: Copyright © 1987 EOSAT. Provided courtesy of EOSAT

Chernobyl, U.S.S.R., on Apr. 29, 1986. The first image collected by satellite of the nuclear reactor is illustrated using band 7 of the Thematic Mapper. The reactor facility (circled) and surrounding agricultural areas are clearly illustrated and defined, and the still-burning reactor can be identified by a bright pixel—whose digital evaluation helped the United States determine the correct status of the reactor during the incident. Evaluation of infrared and thermal imagery of the reactor cooling pond also confirmed U.S.S.R. reports of plant shutdown and startup.

> . . . nuclear powerplants must have cooling ponds and effluents and no one looked at the imagery to say, "where is the effluent for the second reactor?"

Another panelist countered that it was one thing to say that:

> . . . any idiot knows that a nuclear reactor has an effluent pond, but what makes the problem hard is that you don't know which idiot to hire. If you're going to do lots of stories about nuclear reactors you hire people who know that nuclear reactors have effluent ponds. If, on the other hand, you are going to have a lot of stories about forest degradation you need to have people who know a lot about forests.

It was clear from the workshop discussion that if the media intend to use satellite imagery extensively they must solve the interpretation problem. This would mean either hiring photointerpreters —much as they now hire meteorologists—or relying on outside contractors (the so-called "value-added" industry) to turn the raw satellite data into newsworthy information. At present, the value-added industry is small and, like the commercial remote sensing companies, is not organized to respond to the needs of the news media. But, as one panelist pointed out, a news organization's most important asset is its credibility. Most panelists thought that the industry would be able to solve the interpretation problem once it had more experience with the technology.

Assuming the media could arrange to receive most data in a timely fashion and arrange for their interpretation, it might still be difficult to get assured access to politically sensitive data. Government support and control of the two existing commercial systems and the operational independence of the foreign ground stations create at least the possibility that governments could, on occasion, prevent politically sensitive data from reaching the media.

Both EOSAT and SPOT rely on foreign ground stations to collect data when the satellite cannot communicate with earth stations in the United States or France. The owners of the Earth stations pay an annual fee which allows them to collect the data from their region and sell it. The Earth station owners pay royalties on sales of the regional data. In the case of the Landsat Earth stations, the Memorandum of Understanding (MOU) is between the U.S. Government (with NOAA [the National Oceanic and Atmospheric Administration] as the U.S. representative) and the foreign government. Under the U.S. MOUs, foreign ground stations are supposed to provide nondiscriminatory access to all purchasers. In practice, however, the ground stations can refuse to sell data, delay the shipment of data, or deny that data even exist.[19] The only recourse after a ground station's refusal to honor the "nondiscriminatory access" clause of their contract is for the U.S. Government to terminate service to that ground station. This would mean a loss of the annual fee ($600,000 in the case of the U.S. MOUs) and, given the unreliability of on-board tape recorders and the uncertain status of NASA's Tracking and Data Relay Satellite System (TDRSS),[20] the potential loss of a great deal of data.

All of these problems notwithstanding, perhaps the biggest difficulty the media have with current systems is their limited resolution. Neither EOSAT nor SPOT has plans to provide the very high resolution sought by the news media. Several panelists pointed out that focusing on high resolution was, in some respects, misleading—the question is not what is the best technology the media can buy, but rather, what does the media need? If the media's primary use of satellites is to show a typhoon in Bangladesh, a volcano in Hawaii, or an oilspill off the coast of England, then there is no reason to incur the costs associated with very high resolution. If, on the other hand, the media wish to count tanks in East Germany or show the effects of street rioting in South Africa, then the news media would probably want the highest resolution they could afford.[21]

Other panelists suggested that the media had yet to make innovative use of the available low-resolution imagery. "Spatial resolution is only part of the game," cautioned one panelist, "We are only beginning to understand spectral [see box C] differences." Because different objects reflect light differently, certain objects are identifiable even though they are smaller than the spatial resolution of the sensor. For example, a road or a river might be less than 10 meters wide and yet still appear on an image of 30 meter resolution if the road or river reflected light in a substantially different manner than the surrounding area. One panelist recalled:

> When we looked at the high spatial resolution data from Chernobyl it was hard to tell how many reactors were damaged, but on the spectral data the fact that one reactor was burning popped out immediately.

Another panelist cautioned that, although spectral differences were important, when EOSAT brought back images of China, the Great Wall was not visible in certain spectral bands because the Wall was made from, and therefore reflected light in the same wavelength as, the surrounding rock. Panelists agreed that each system has its own specific strengths and limitations, and that to date, the media had not used the available images creatively.

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[19] When a buyer asks EOSAT for data that were collected by a foreign ground station, EOSAT must request that the foreign ground station sell EOSAT those data. One panelist pointed out that certain countries were notorious for refusing to release data. For example, the panelist said that it was very difficult to purchase data from India, particularly if they contained scenes of the India/Pakistan border.

[20] It is important to note that, as a result of the cost, complexity, and limited access to TDRSS, EOSAT does not have plans to include TDRSS communication packages on its next two satellites.

[21] It is interesting to note that of all the remote sensing images used in *Aviation Week and Space Technology*—including many mages of the Soviet Union and of Soviet technology—the images that generated the most sustained interest were those of the Mount St. Helens explosion. Several panelists predicted that the media would find a large demand for satellite images of major natural events.

Implement Mediasat Concept

If the media should decide that satellite imagery was very valuable, but that the operating procedures of the current commercial systems were too rigid or that access to high-quality data could not be assured, then the media might be driven to develop their own system. The exact nature of this system would be the product of two important considerations. First, the media would have to decide on the appropriate level of technology, which would include, but not be limited to, a choice of the resolution of the sensors to be used (e.g., 5 meter, 3 meter, etc.) Second, the media would have to decide how much they could afford. These two considerations are very closely related.

If a mediasat is to become a reality, the news media must be able to assess the value of both current satellite images and successive technical improvements. As a result of the media's inexperience using satellite imagery, the uncertainties regarding the present market for data, and the lack of credible cost estimates for high-resolution imagery, deciding how good is "good enough" is a difficult task. During the workshop, several participants suggested that 5 meter resolution might meet the needs of the news media. Yet, when one panelist illustrated the effect of increased resolution by showing 10 meter and 5 meter images of Washington, D.C., several panelists were noticeably unimpressed. "You say that 5 meter resolution will produce good pictures," commented one participant, "I still say it's a source story [see box E]. You show that picture and you will have people saying: 'What is this? You're telling me this is Washington? It looked to me like New York.' " Another panelist, familiar with satellite imagery countered that, "You ought to take a look at this under a magnifying glass. There is a great deal more information in this 5 m picture than in the 10 m picture." This interaction highlighted one of the basic dilemmas facing the news media—how to assess the value of increased information when that information can be transmitted to the consumer only imperfectly.[22]

If cost were not a consideration, the media might want the highest resolution pictures they could get, but costs rise dramatically as resolution increases. This results, in part, from the fact that the data rate[23] rises as the inverse square of the resolution. This means that, assuming the satellite is covering the same area, as resolution improves from 10 meters to 5 meters, the amount of data that must be collected, transmitted, and processed increases by a factor of 4. Similarly, improving the resolution to 2.5 meters would increase the original 10 meter data rate by a factor of 16. This led some panelists to conclude that data rate could influence the ground segment costs for the mediasat system more than any other single element.[24]

Panelists cautioned that although increased data rate was a "problem," it was possible to identify some potential solutions. Data rate, it was argued, could be greatly diminished by using the satellites to take pictures of specific, pre-identified events (e.g., an oil tanker beached on the California coast, a hijacked airplane sitting on the tarmac in Tripoli), rather than taking pictures of the entire Earth and then sifting through the raw data in the hopes of finding "news." In addition, data compression techniques could be used to greatly diminish the data flow problem.[25]

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[22] Following the workshop, OTA received a letter from Earl S. Merrit, Vice President of EarthSat, a corporation specializing in the "value-added" business of imagery processing. The letter, which called into question the value of even very high resolution imagery, stated:

> [T]he satellite-acquired information will always be "source" material even if the resolution was 1 meter due to [the need for expert interpretation]. This fact would seem to provide a "damper" on the network use of such source material since the number of "experts" in interpretation is limited. Thus, I see the networks eventually using the "source" to highlight a story but not to provide the bottom line . . . human-intelligence gathering "journalism" will continue to dominate news gathering.

[23] Data rate refers to the flow of information about the picture "seen" by the satellite's sensor. At higher resolutions the pictures are more detailed and therefore contain more information. In order to transmit more information about the same scene in the same time period, the data rate must increase.

[24] EOSAT's 30 meter TM sensor has a data rate of 85 million bits per second (MBPS). The data rate for a 5 meter mediasat with the same swath width would be 3,060 MBPS. By narrowing the swath width (therby reducing the coverage) and using data compression techniques, the data rate could be reduced to the 100 to 150 Mbps range. Even this much reduced data rate would require more sophisticated data systems in both the sensor and the satellite than we now possess.

[25] Data compression is a process that reduces greatly the amount of data which must be transmitted from the spacecraft to the ground station. Although there are many data compression techniques, most operate by reducing or eliminating the redundancy that is inherent in raw data. Where the quality of the resulting image is to be judged by subjective criterion such as visual appearance—as may be the case with media images—the transmitted data need only be sufficient to construct a facsimile of the orginal data. Under these circumstances—and depending on the amount of redundancy in the data—compression ratios of more than a factor of 2 could be achieved.

Photo credit: Copyright © 1987 CNES. Provided courtesy of SPOT Image Corp., Reston, VA

Baltimore city and Baltimore harbor. Ten meter panchromatic image taken by the SPOT satellite.

Increased data flow was not the only problem identified by the panelists. One technical expert noted that while a 5 meter sensor could be flown on a "host" satellite or a relatively inexpensive satellite bus, at very high resolutions, spacecraft stability becomes a problem. Therefore, flying a sensor of 3 meter resolution or better would require a more sophisticated and much more expensive satellite. The combined effect of increased data rate, more complex and expensive sensor systems, and more rigorous demands on the satellite bus, could mean that even slight increases in resolution could have a dramatic effect on costs. One panelist estimated that an entire mediasat system (i.e., sensors, satellite, communication links, ground processing and distribution) with a 5 meter resolution might be obtained for as little as $215 million for a one-satellite system. A comparable 1 meter system, on the other hand, might require a multi-billion dollar investment. (See app. A, table A-3, for alternative cost estimates.)

Throughout this discussion, panelists made clear that cost, not the availability of advanced technology, was the limiting factor in achieving high-resolution images. As one panelist put it, "3 meters is do-able, just bring your checkbook."

One panelist argued that, in light of the financial resources of the television networks, the cost issue was being exaggerated. He pointed out that ABC "paid $309 million just to buy the rights to the '88 Olympics and will spend another $300 million to produce it." Others felt that the value of such comparisons is doubtful, because such large expenditures are made only in light of a carefully

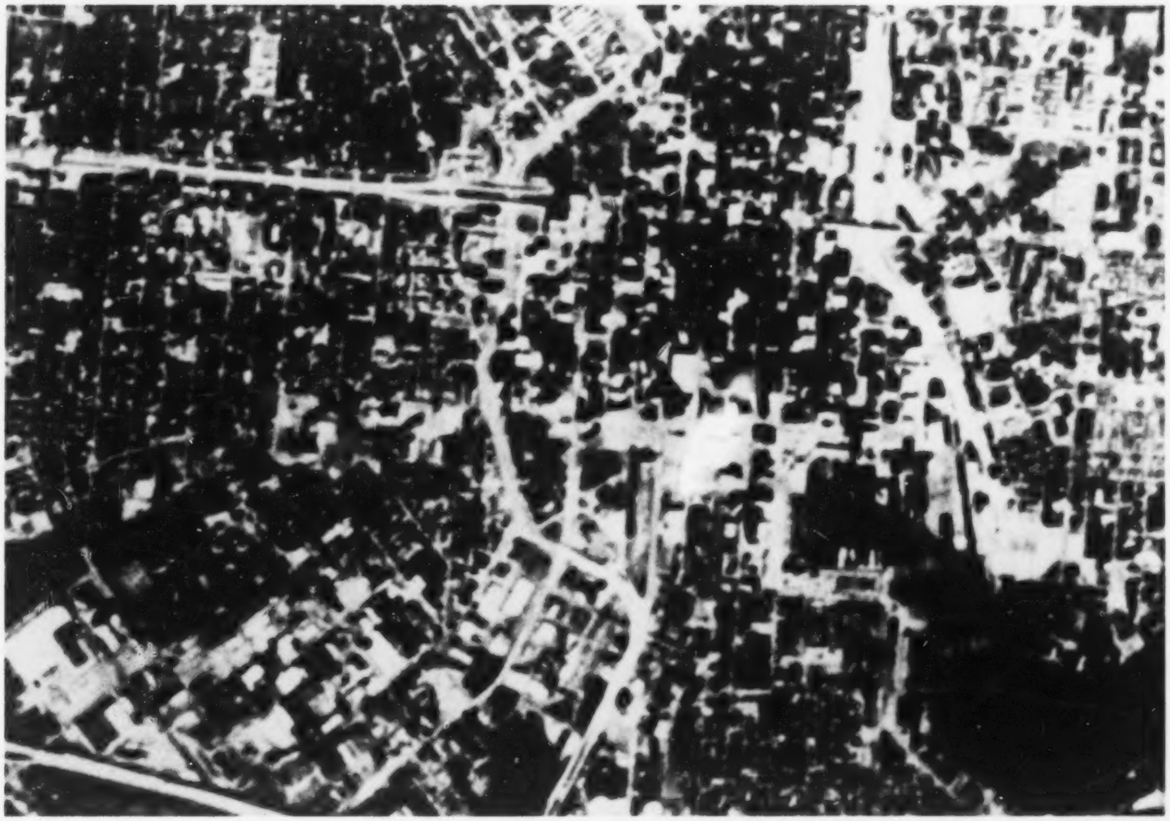

Photo credit: Copyright ©1987 CNES. Provided courtesy of SPOT Image Corp., Reston, VA

Baltimore harbor area. Ten meter panchromatic image taken by the SPOT satellite.

calculated expectation that they will increase revenues at least as much.

The hard question, then, is *"what value would satellite images add to current news stories?"* or, more to the point, *"what additional news stories and revenue could be generated by the use of satellite imagery?"* Obviously, satellite images would not be useful in all of any given day's news stories. Even assuming that ABC, CBS, NBC, and CNN use one satellite image per evening every day of the year, it is difficult to imagine how revenues could be generated to offset the cost of a $215 million to $470 million satellite system. If all four major networks used 1 satellite image every night, this would mean that about 1,500 images would be used every year. If one assumes that a mediasat would cost approximately $215 million to $470 million to build and launch, and another $50 million to $75 million to operate over a period of 5 years ($10 million to $15 million per year), then the average cost over the 5-year period would be $53 million to $109 million per year. Putting these admittedly speculative figures together, one concludes that each satellite image would have to be worth about $35,000 to $73,000 to the networks (see app. A for cost assumptions). Given that the average network news story is produced for less than $5,000, it is hard to imagine how the networks could justify this additional expenditure.[26]

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[26] Several panelists felt that OTA cost and demand projections were too pessimistic. One panelist stated:

> I particularly want to challenge the assertion that each network would not use images every day. It reminds me only too well of the similar statements made . . . in the wake of the first Telstar feeds to the United States from Europe and the confident predictions that there was no possibility that such programming would ever become commonplace because the intercontinental link would always be too costly.

There are ways that the news media might try to reduce the cost of a mediasat system: they could form a consortium—either domestic or international—to share the cost, they could resell data to other users to subsidize their own use,[27] or, they might wait until technical advances reduce the cost of sensors, satellites, and launch vehicles.[28] At present, it is unknown whether any of these measures, or combinations of measures, would reduce the cost of a mediasat to the point where it would be economically viable today. Two points, should however, be kept in mind: first, it is impossible to estimate accurately the future demand for remotely sensed data; and second, simple calculations that compare the cost of a mediasat and potential mediasat revenues could be misleading. It is difficult to describe the value of a press "exclusive," and, as banks have recently demonstrated with their electronic teller machines, there is value in providing new services.[29]

Some panelists expressed the view that interested governments should combine their resources in an INTELSAT-like organization to ensure continued, cost-effective access to remote sensing data. Inherent in this concept is the belief that a mediasat would not be economically viable even if funded by a consortium of news agencies. In one panelist's opinion:

> The money received from Chernobyl would fit in a thin wallet. When will there be another such accident located in a place where we cannot fly in with a good hand-held camera? An international governmental consortium is the best way to ensure the continued availability of remote sensing data. It could begin to form when EOSAT and SPOT get tired of throwing money at the problem, when Congress takes Gramm-Rudman-Hollings seriously, and when someone sees other countries as a set of partners eager to help share costs, and more importantly, help promote the use of [remote sensing] systems.

Finally, it should be noted that some experts see "mediasat" as one aspect of a more profound transition of the news networks from the status of news providers to a much broader role in the information industry. As one panelist noted:

> It is my belief that the largest market for medisat data will not be the news divisions but rather the secondary markets. Media companies will sell the interpreted data to buyers around the world . . . and will change their structure to become huge value-added entities . . . The media [will never] be able to spend the amounts of money for a mediasat without aggressively opening new markets around the world.

Should the networks undergo the radical transformation foreseen by this panelist, the assumptions and conclusions of this technical memorandum would have to be similarly modified. The likelihood and prospects of such a transformation are beyond the scope of this technical memorandum. Box G and tables 2 and 3 provide information on many of the possible uses for remotely sensed data beyond newsgathering.

Table 2.—Remote Sensing Data Needs of Foreign and Domestic Users

- *Agriculture* (Federal, State, and private): specific sampling areas chosen according to the crop; time-dependent data related to crop calendars and the weather patterns
- *Forestry* (Federal, State, and private): specific sampling areas; twice per year at preselected dates
- *Geology and nonrenewable resources* (Federal, State, and private): wide variety of areas; seasonal data in addition to one-time sampling
- *Civil engineering and land use* (State and private): populated areas; repeat data required over scale of months or years to determine trends of land use
- *Cartography* (Federal, State, and private): all areas; repeat data as needed to update maps
- *Coastal zone management* (Federal and State): monitoring of all coastlands at selected dates depending on local seasons
- *Pollution monitoring* (Federal and State): broad, selected areas, highly time-dependent needs both for routine monitoring and in response to emergencies
- *Newsgathering* (private): selected areas; highly time-dependent needs in response to fast breaking news stories

SOURCE: Office of Technology Assessment.

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[27] It is significant to note that total remote sensing data sales between 1979 and 1984 only produced a little over $30 million. *See:* "Landsat Data Users Notes," No. 35, March 1986, p.7.

[28] Many of the technologies currently being investigated by the Strategic Defense Initiative Organization (i.e., inexpensive launch vehicles, satellites, and sensors) could make mediasat a reality.

[29] One panelist, noting that the fortunes of the major networks had been in decline recently, argued that a mediasat might be justified partly on the grounds that while a network might be able to operate a mediasat, its affiliates could not do so on their own. Therefore, a network might want to operate a mediasat because it could hold the network together, thereby preserving other revenues.

Box G.—Remote Sensing and the Public Interest

U.S. land and meteorological remote sensing systems have from the beginning been intended to serve the public interest, whether primarily for research, as in the case of the Landsat system, or for operational weather forecasting and severe weather warning, as in the case of the meteorological satellite systems.

The Landsat system has demonstrated to a small but dedicated group of customers, both inside and outside the government, that satellite data can be highly effective in meeting their resource information needs. Land remote sensing systems serve a wide variety of data users (table 2), most of whom require satellite data of 10 to 100 meters resolution on time scales of weeks to months. However, the agricultural community and those who monitor the courses of natural and manmade disasters have need for data on a more timely basis.

It is clear from examining table 3 that the public interests and those of the media are often synonymous. Data from a mediasat could make an important contribution in warning of and assessing natural and manmade disasters, as well as in managing disaster recovery.

The value-added industry has developed a number of techniques for converting data to information that would serve the public good. Some of these would be of interest to the media:

- use of time lapse images to compare scenes over time;
- overlay of black and white imagery with spectral imagery to bring out features not visible in either;
- use of ground-based images to illustrate features close-up; and
- using stereo pairs to generate three-dimensional images from different perspectives.

As one expert on photointerpretation and remotely sensed imagery has pointed out:

> . . . remote sensing technology, properly applied, could save countless lives and billions of dollars in property damage each year. Few outside the military and intelligence [communities] are aware of this resource. Fewer still know how to interpret that technology and even fewer know how and when to apply it. Yet it is the same technology with which the United States monitors SALT and the Middle East Truce Agreement, observes and predicts crop yields in the Soviet Union, Australia, Canada, Argentina, and India, and assesses damage caused by such catastrophes as the Italian, Guatemalan, and Alaskan earthquakes.
>
> . . . If existing multisensor imagery had been analyzed, the plight of 150,000,000 in Ethiopia and other African countries could not only have been predicted, but actions taken before disaster struck.[*]

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[*] Dino Brugioni, *Air Force Magazine*, October 1985.

Table 3.—Summary of Applications of Landsat Data in the Various Earth Resources Disciplines

Agriculture, forestry, and range resources	Land use and mapping	Geology	Water resources	Oceanography and marine resources	Environment
Discrimination of vegetative types: Crop types Timber types Range vegetation Measurement of crop acreage by species Determination of range readiness and biomass Determination of vegetation vigor Determination of vegetation stress Determination of soil conditions Determination of soil associations Assessment of grass and forest fire damage	Classification of land uses Cartographic mapping and map updating Categorization of land capability Separation of urban and rural categories Regional planning Mapping of transportation networks Mapping of land-water boundaries Mapping of wetlands	Recognition of rock types Mapping of major geologic units Revising geologic maps Delineation of unconsolidated rock and soils Mapping igneous intrusions Mapping recent volcanic surface deposits Mapping land forms Search for surface guides to mineralization Determination of regional structures Mapping linears (fractures)	Determination of water boundaries and surface water area and volume Mapping of floods and flow plains Determination of aerial extent of show and snow boundaries Measurement of glacial features Measurement of sediment and turbidity patterns Determination of water depth Delineation of irrigated fields Inventory of lakes	Detection of living marine organisms Determination of turbidity patterns and circulation Mapping shoreline changes Mapping of shoals and shallow areas Mapping of ice for shipping Study of eddies and waves	Monitoring surface mining and reclamation Mapping and monitoring of water pollution Detection of air pollution and its effects Determination of effects of natural disasters Monitoring environmental effects of man's activities (lake autrophication, defoliation, etc.)

SOURCE: N.M. Short, P.D. Lowman, Jr., and S.C. Freden, *Mission to Earth: Landsat Views the World*, NASA Scientific and Technical Office, 1976.

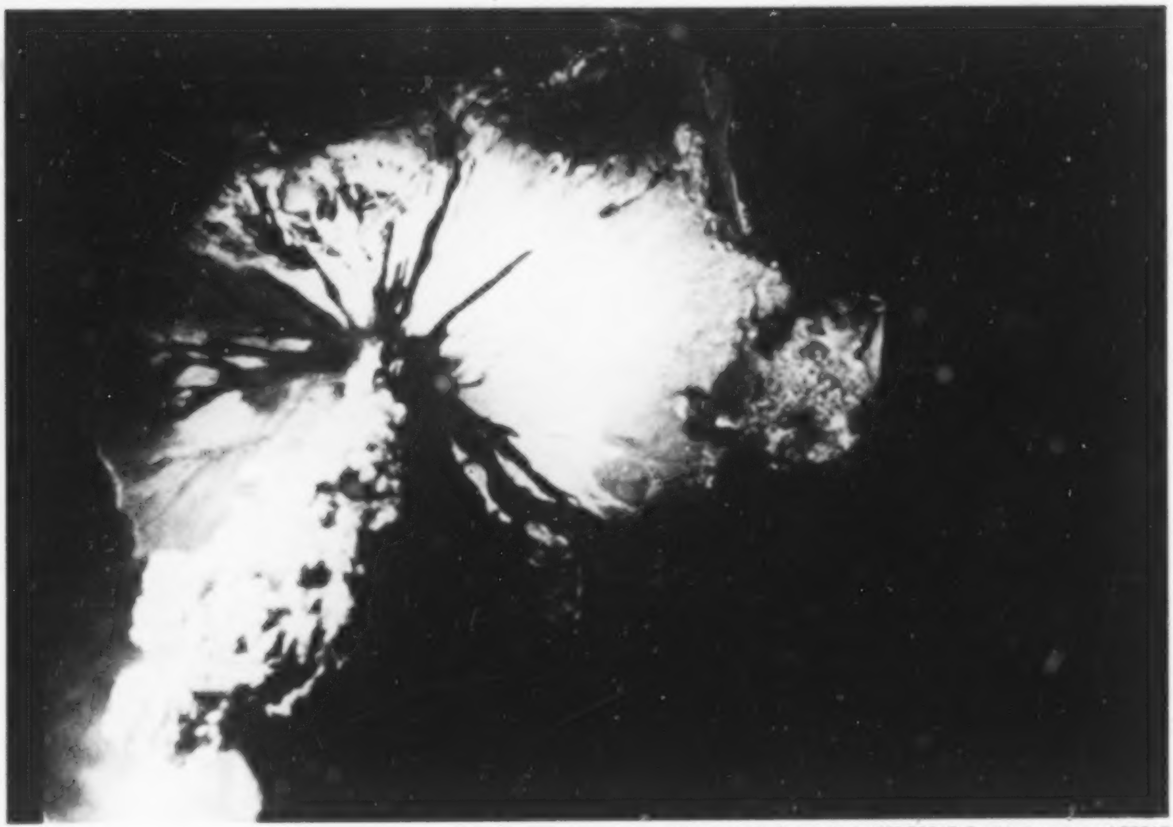

Photo credit: Copyright © 1987 EOSAT. Provided courtesy of EOSAT

Portion of Landsat 5 Thematic Mapper image showing Augustine Volcano, Alaska during eruption on Mar. 27, 1986. Band 4, in the near infrared, clearly defines snow/cloud area from surrounding vegetation and terrain, with 30 meter ground resolution.

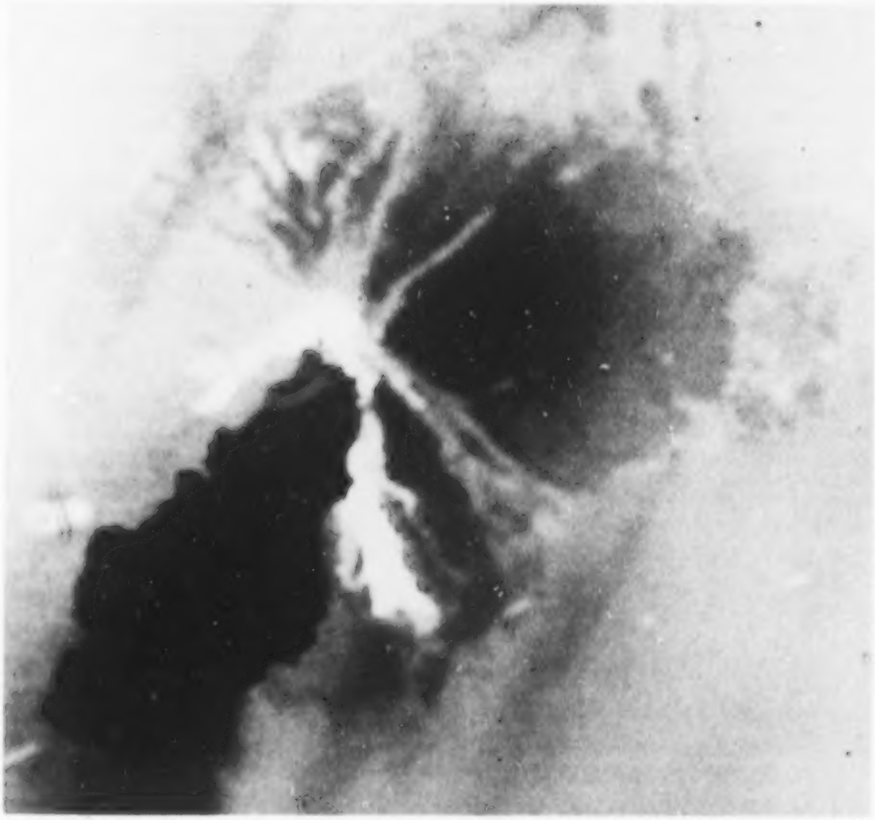

Photo credit: Copyright © 1987 EOSAT. Provided courtesy of EOSAT

The 120 meter thermal band on the Thematic Mapper displays the hot flow at the north end of the Augustine Volcano through the smoke and cloud cover. By combining the spectral bands of the Thematic Mapper, the clarity of 30 meter resolution is complemented by thermal information.

NATIONAL SECURITY AND FOREIGN POLICY

So far, this paper has examined the desirability and feasibility of a mediasat from the perspective of the press. It is also important to examine the U.S. Government's interests, attitudes, and concerns regarding this concept. The remainder of this technical memorandum will focus primarily on the tensions that are certain to develop between this Nation's commitment to freedom of the press and its commitments to current national security and foreign policies. As one author framed the problem:

> In a robustly pluralist society such as ours, free speech is easy to accept and to enjoy, and in a hostile, potentially lethal international environment such as the one in which we live, national security seems a fundamentally worthwhile pursuit. The difficulty lies in making tradeoffs.[30]

In the preceding discussion, this technical memorandum concluded that, in the near-term, the high cost of gathering and processing satellite imagery would inhibit the news media's attempts to establish a mediasat. Nonetheless, in the long run, the media are likely to continue using satellite imagery and gain access to increasingly sophisticated remote sensing technology. Accepting this fact, the United States will eventually have to balance the guarantees of free speech and the need for national security with respect to media use of remotely sensed data from spacecraft.

National Security Concerns

Experts generally agree that the media's extensive use of high-resolution satellite imagery for newsgathering could complicate certain U.S. national security activities and certain U.S. foreign policies. They also agree that this Nation's strong and unwavering commitment to the principle of freedom of the press has served it well. The task, therefore, is to balance these two fundamental concerns. As the following discussion illustrates, the arguments on both sides of this issue are strong and clear choices are few.

Participants identified and discussed five sets of national security and foreign policy concerns during the workshop.

1. Dissemination of Information Concerning U.S. Military Operations

Some panelists expressed the concern that, without adequate oversight of a mediasat, the media might disclose information concerning U.S. military operations under circumstances that could result in casualties and/or frustrate U.S. objectives. The disclosure by the media of information concerning U.S. troop movements, shipments of materiel, or the location or heading of ships and cargo planes could deprive U.S. troops of the element of surprise—a critical tactical advantage in fast-paced, modern warfare.

The most common media response to such allegations is that, although a mediasat could provide a substantial new source of data, the media's extensive contacts and information sources within the United States and around the world already provide the press with real-time information concerning fast-breaking news stories. "The system leaks like crazy anyway," asserted one panelist, "I find it hard to get excited over the incremental damage that a mediasat could do." The media are also quick to assert that their past record is a good one. Where lives were at stake or serious national security issues in question, they argue that the news media have acted responsibly, often refusing to release information that would seriously prejudice national security.[31]

One media representative said that in 1986, his network's correspondent was flying in a chartered airplane and saw the U.S. fleet turn south towards Libya hours before the United States' retaliatory bombing. Although this information was radioed to the network affiliate in Rome and then passed back to the United States:

> We did not go on the air with it because we realized that specific lives were in jeopardy . . .

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[30] Paul B. Stephens, *The First Amendment and National Security*, Center for Law and National Security, University of Virginia, vol. 1:2, May 1984, p. 1.

[31] Although the workshop participants generally accepted the proposition that the news media acts responsibly, a minority of experts and media pundits have argued the opposite. For example, analysts at Accuracy in Media, Inc. (AIM), have argued generally that the media's "policy of publishing sensitive information . . . may jeopardize the lives of innocent people." (*See:* "AIM Report," July-A, 1985, No. XIV-13, p.1) The media have been criticized for speculating about sensitive programs such as the launches of classified DOD payloads on the Space Shuttle. More recently, the media were criticized because some felt that they were putting the lives of the Beirut hostages in danger by speculating on the nature of U.S. efforts to free them.

> It is our policy that when there is a specific issue of life or death we will not broadcast that information.

Another panelist commented that although the network's restraint in the Libyan incident was commendable:

> I assume you don't have fancy cryptographic communication equipment; therefore, you gave Libya the message when you radioed it from the airplane to the ground station.

This comment identifies two important problems:

1. the media have only a limited ability to protect sensitive information even if they desire to do so; and
2. the national security community may have to rely on the press' restraint to withhold information that once was under the control of the national security community.

Some media experts argue that a "newsgathering" satellite would work to the advantage of the United States by providing additional reconnaissance capability. It would be more difficult for nations to cheat on treaties or hide hostile activities if faced with frequent overflights by both media- and government-owned satellites.

2. Retaliation by Foreign Governments for Media Disclosures

Recent world events have demonstrated the strange symbiotic relationship that exists between the U.S. Government and the U.S. news media. The taking of media hostages in Beirut and the arrest and detention of Nicholas Daniloff in Moscow are just two examples of the willingness of certain foreign governments to use the U.S. media as pawns in their struggle with the U.S. Government. Mediasat raises the opposite concern—that the U.S. Government might be held responsible for the actions of the news media.[32] Some workshop participants expressed the concern that friendly foreign governments might retaliate by expelling diplomats or closing valuable U.S. military bases should the press reveal information that embarrassed or threatened the national security of those nations. Governments already hostile to the United States could resort to terrorism or direct armed aggression.[33]

Some panelists felt that this was neither a significant nor a novel issue, and that although countries might initially complain, eventually they would accept a mediasat as they now accept EOSAT and SPOT.[34] The Soviets, one panelist noted, had complained bitterly through diplomatic channels when the magazine *Aviation Week and Space Technology* first ran pictures of its launch facilities at Tyuratam, but over the years their complaints gradually ceased.[35] Other panelists took an uncompromising view of threats of foreign retaliation. They maintained that this issue was one that should now and always be nonnegotiable by the U.S. Government as it lies at the heart of the principle of freedom of the press. One panelist commented hotly:

> When the Soviets or other countries call and say, "why aren't you stopping that story on the evening news," you say, "we can't, and that's the difference between our country and yours."

3. Loss of Control During a Crisis

Advances in transportation and communication technologies have made the world smaller and reduced the time available to leaders to make decisions. Although far from perfect, the communi-

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[32] The U.S. Government accepted *legal* responsibility for the actions of its citizens in space in the Outer Space Treaty (18 U.S.T. 2410; T.I.A.S. 6347). Article VI of the Outer Space Treaty states:

> States . . . shall bear international responsibility for national activities in outer space . . . whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with . . . (this) Treaty. The activities of non-governmental entities in outer space . . . shall require authorization and continuing supervision by the appropriate State party to the Treaty.

[33] One panelist pointed out that some nations already have, and others may eventually have, the capability to destroy or incapacitate satellites of the types likely to have commercial value.

[34] For many years after the U.S. Landsat program began, many developing countries claimed that a state should not be "sensed" without its prior consent. It is significant to note that the *Principles Relating to Remote Sensing of the Earth From Space* (A/RES/41/65, Jan. 22, 1987), recently published by the United Nations, omits any reference to prior consent. This is at least some indication that as nations become more familiar with this technology and as the technology becomes more widely available, countries will cease to regard it with suspicion.

[35] The initial Soviet complaints resulted in part because this was the first publication of such images and, in part, because of the timing of the release. The pictures appeared immediately before the 1975 Apollo-Soyuz U.S./Soviet link-up in space and may have been regarded by the Soviets as a violation of the "spirit of cooperation" which both governments were trying to project to the world. One panelist noted, however, that the Soviet's ability to disable satellites was far less in 1975 than it is today.

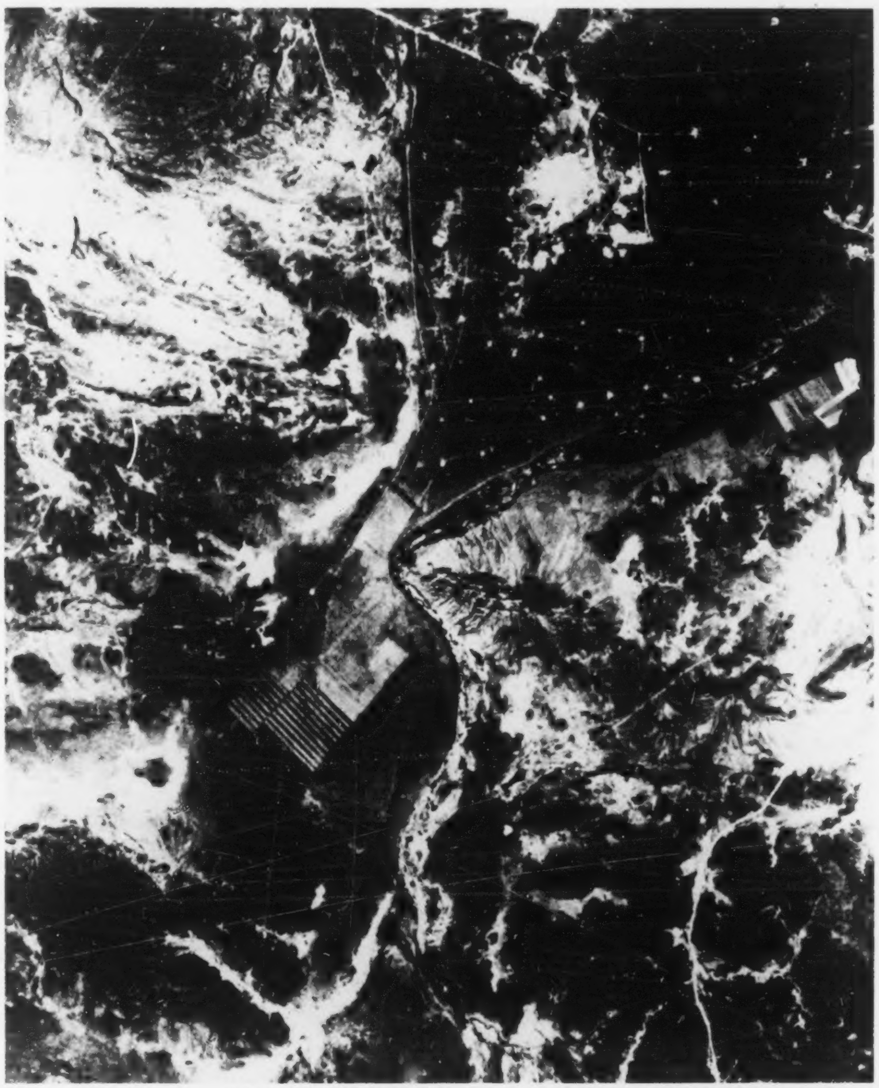

Photo credit: Copyright © 1987 CNES. Provided courtesy of SPOT Image Corp., Reston, VA

Soviet nuclear testing facility, Semipalatinsk, U.S.S.R. Visible are cable scars and access roads connecting with drill holes. Ten meter panchromatic image taken by the French SPOT satellite.

cation and information assets available to world leaders have allowed them to stay just ahead of breaking events. This small grace period has given leaders time to plan and confer with advisors before being forced to make critical decisions that could lead to confrontation or conflict. As mediasats become more capable, some fear that this "grace period" could be reduced to zero and that world leaders would be forced to respond to press reports on which they had little or no information. One analyst noted that President Kennedy had 6 days to formulate a response to the discovery that Soviet missile sites were being built in Cuba. How might the President have handled this crisis had he been forced by media disclosures to respond to Congress, the press, and the American people within the first few hours?

During the workshop, participants put forward two responses to this issue. The first was similar to the response to the issue of dissemination of military information; that is, that a mediasat would provide only an incremental increase over current capabilities. The sophisticated communication equipment now employed by the media already forces world leaders to respond in real-time to breaking news. Second, no matter how advanced the media's assets were, they could never rival the sophistication and timeliness of the entire intelligence apparatus currently available to the superpowers, of which satellites are only a small part.

4. Providing Valuable Intelligence to Third Parties

The United States and the Soviet Union still hold a virtual monopoly on sophisticated, global reconnaissance data. These data are, for the most part, jealously guarded, although in certain circumstances discrete portions of these data have been released to aid allies or confound adversaries. Some panelists expressed concern that mediasat activities, by making satellite images more generally available, would erode this important U.S. advantage. Workshop participants were unable to reach consensus on either the dangers posed by this potential erosion or the nature of the supposed advantages now enjoyed.

The issue seems to turn on the judgment that: 1) there exists a sizable set of issues about which the United States and the Soviet Union would have a common interest in withholding or controlling the flow of information, and 2) the fact that Soviet reconnaissance systems *could* detect something does not necessarily mean that they *have* detected it. Some panelists simply discounted the importance of the first concern, stating that, "the situations where the United States wants to conceal something from a third country that the Soviets wouldn't cooperate with would be few and far between." In response to the second concern, certain panelists noted that the likelihood that commercial news gathering satellites would find out things that the Soviets didn't already know was, "conceivable but extremely unlikely."

5. Dangers of Media Misinterpretation of Data

The previous section has already discussed the problems that the media have had in interpreting the satellite imagery they have already obtained. Some panelists expressed fears that inaccurate reporting—caused primarily by the strong pressure to "break the news"—could precipitate a crisis. For example, one expert recently wrote that:

> [S]everal networks showed SPOT photographs of the Soviet nuclear proving grounds at Semipalatinsk and claimed that the Soviets were preparing to resume nuclear testing. They showed photos of what was described as a "drill site." Looking at the photo, any competent imagery analyst would have pointed out that the arrangement and the cable scars terminating at the site would have proved that it was not a drill site but rather an instrumentation site, common to all nuclear proving grounds.[36]

It is conceivable that similar media misinterpretations on more serious issues such as troop movements or arms control violations could seriously disrupt international affairs. Some media experts discount this concern, arguing: first, that as the media continue to use satellite data they will grow more sophisticated and become less prone to error; and second, the common practice of verifying major stories with multiple sources of information should reduce the likelihood of misinterpretation.

One panelist felt that the media should be forced to use a common pool of qualified analysts to ensure that image misinterpretation was kept to a bare minimum. Most panelists strongly disagreed with this suggestion, claiming that:

> It's part of the process of free speech to permit and encourage diverse interpretation. Attempts to limit interpretation will have a direct impact on the American people's ability to get information and make their own judgments.

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[36] D.A. Brugioni, *Satellite Images on TV: The Camera Can Lie*, Washington Post, Dec. 14, 1986, p. H1, col. 1.

The Effect of Foreign Remote Sensing Systems on U.S. Policies

Within a decade, many nations will have their own remote sensing systems. The U.S. Government cannot effectively limit or control media access to satellite imagery if foreign governments do not exercise similar controls. At present, the only non-U.S. *commercial* remote sensing system is France's SPOT. However, research-oriented remote sensing systems are currently under development by Canada, China, the European Space Agency, India, and Japan. Japan launched its first Marine Observation Satellite (MOS I) in February 1987. In addition, instruments flown on the shuttle and on the proposed international space station and its related polar platforms will supply another source of high-quality data with potential media application. All these systems, even those not considered "commercial," add to the pool of data available for exploitation by the media.

The almost assured proliferation of sophisticated remote sensing systems has caused many analysts to question the practicality—except for minimal launch vehicle and payload licensing[37]—of attempting to regulate the media's use of satellites to gather news. The most obvious means for controlling a mediasat organization would be to: 1) allow the launch of only certain types of satellites (e.g., limit the type and resolution of sensors); 2) control what the satellite takes pictures of in orbit; and/or 3) limit the flow of data from the satellite to the end user. Disregarding for the moment the constitutionality of any of these proposals, U.S. laws attempting to accomplish one or more of these tasks would not be applicable to foreign systems. As a result, U.S. news agencies could purchase data from, or invest in, foreign remote sensing systems. In the opinion of some panelists, the only effect of U.S. limitations would be to stifle a domestic mediasat industry.

Others argue that foreign remote sensing systems—either as a result of high costs, less sophisticated technology, foreign government policies, or a simple lack of need for high-resolution images—may have only limited capabilities.[38] Therefore, with minimum international coordination, U.S. policies could substantially delay the time when the media would have access to very high-resolution satellite images. The U.S. Government might attempt to negotiate agreements[39] with other countries regarding sensor resolution or data dissemination. Such agreements would certainly be opposed by the news media and, given the U.S. commitment to both the freedom of the press and the "open skies" policy,[40] it is not certain how much support such agreements would find in either Congress or the executive branch.

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[37] Both the Land Remote-Sensing Commercialization Act of 1984 [15 U.S.C. 4201-4292] and The Commerical Space Launch Act [49 U.S.C. 2601-2623] require licensing for private systems operated within the United States.

[38] The option of a satellite owned by a U.S. entity but launched under a foreign "flag of convenience," to evade U.S. Government regulation appears to be foreclosed by the recent 7 national agreement not to export rockets that could serve as long-range missiles—and therefore also rockets capable of launching satellites into polar orbits. See John H. Cushman, Jr., "7 Nations Agree to Limit Export of Big Rockets," *The New York Times*, Apr. 17, 1987, p. 1.

[39] Such an "agreement" could be a formal treaty or a more flexible set of gentlemen's agreements concerning topics such as sensor resolution or data distribution. COCOM is a current example of such an informal agreement. COCOM coordinates the export control regimes of the member nations but COCOM agreements have no legal standing in any of its member nations.

[40] To reduce tensions between the United States and the Soviet Union, President Eisenhower in 1956 suggested to the Soviets that each country should allow the other to overfly its territory on a regular basis. Although the Soviets rejected this suggestion as a transparent espionage device, the United States' continued commitment to the principle of "open skies" allowed it to support its later assertion that spaceborne reconnaissance was a peaceful activity. *See:* Walter A. McDougall, *The Heavens and the Earth* (New York: Basic Books, Inc., 1985), p. 127.

NATIONAL SECURITY AND THE FIRST AMENDMENT

The first amendment provides that "Congress shall make no law . . . abridging the freedom . . . of the press." Since the adoption of the Constitution, the Supreme Court has repeatedly affirmed the depth and breadth of its commitment to these few powerful words, even when confronted with serious national security concerns. Although it would be possible to write a treatise on the legal issues that a mediasat *could* generate, this paper is concerned with merely outlining the issues related to two narrowly drawn questions:

1. Are there restrictions that the government could impose in the interests of national security that would pass constitutional muster?
2. Is the licensing scheme established in the 1984 Remote Sensing Act a reasonable exercise of U.S. domestic and international responsibilities and is it consistent with the first amendment?

Mediasat Restrictions and the First Amendment[41]

Before one can assess the constitutionality of mediasat restrictions, it is important to consider the legal status of newsgathering. In *Branzburg* v. *Hayes*, the Supreme Court held that newsgathering qualifies for some first amendment protection, because "without some protection for seeking out the news, freedom of the press could be eviscerated."[42] But, the Court in *Branzburg* did not say—and has never said—that newsgathering is due the same degree of protection afforded traditional speaking and publishing activities. Indeed, the Court has upheld restrictions on newsgathering where reporters sought access to government facilities or government information not generally available to the public.[43] The degree of protection ultimately granted to news gathering activities will determine which restrictions the U.S. Government could properly place on a mediasat. Unfortunately, until the Supreme Court has occasion to rule on this specific issue, it will not be settled decisively.

As noted above, should the U.S. Government desire to inhibit a media-owned satellite from gathering potentially sensitive information it could—either permanently or during a crisis—attempt to limit: 1) the resolution of the satellites sensors, 2) the images that the satellite is allowed to collect, or 3) the images the media may disseminate. If news gathering is granted the highest degree of first amendment protection, all such restrictions might well be regarded as impermissible "prior restraints" on free speech. The doctrine of "prior restraint" holds that advance limitations on protected speech may not be "predicated on surmise or conjecture that untoward consequences may result."[44] Prior restraints are allowable only if necessary to prevent "direct, immediate, and irreparable damage to our Nation or its people."[45] If newsgathering is given full first amendment protection by the Supreme Court, U.S. Government restrictions would have to meet the strict tests required of allowable "prior restraints." On the other hand, should the Court decide that news gathering was deserving of some lesser degree of protection, the government would have considerably more latitude to limit mediasat activities.

But even if the government could not meet the strict "prior restraints" test, it could still enforce post-publication sanctions.[46] Federal espionage laws prohibit gathering or transmitting defense information, photographing defense installations, publishing or selling photographs of defense installations and the disclosure of classified information.[47] Should the media violate any of these laws by disseminating satellite images, the government could—subject to the limitations of the first amendment—prosecute those responsible.[48]

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[41] This paper discusses only the first amendment issues raised by a mediasat. Media owned satellites would, of course, be subject to all the domestic laws and regulations (e.g., Federal Communication Commission regulations, Space Launch Act of 1984) that would apply to other satellites. In addition, treaties that have been signed and ratified, such as the 1967 Outer Space Treaty and the 1972 Liability Convention, are legally binding on private sector activities.

[42] 408 U.S. 665, 681 (1972).

[43] *See: Pell v. Procunier,* 417 U.S. 817 (1974), and *Saxbe v. Washington Post Co.,* 417 U.S. 843 (1974).

[44] Justice Brennan concurring in, *New York Times Co. v. United States* (The "Pentagon Papers" case), 403 U.S. 713, 724 (1971). The ruling in *New York Times* was a brief *per curium* decision, but each Justice elaborated on his views in a separate concurring or dissenting opinion. *See also: Near v. Minnesota*, 283 U.S. 697 (1931).

[45] Justices Stewart and White, concurring, *New York Times Co. v. United States,* Id.; To date, the only case which upheld a prior restraint in this context is a 1979 decision by a U.S. District Court, *United States v. The Progressive, Inc.* (467 F.Supp. 990 (W.D. Wis.)). In that case the court issued an injunction against a magazine that was planning to publish a detailed description of hydrogen bomb technology.

[46] Although they do not involve issues of "prior restraint," post-publication sanctions must still be consistent with the first amendment.

If the media do not own the satellite system, but rather rely on a commercial company such as EOSAT to provide it with data, it would be less clear whether the media could successfully argue that licensing restrictions violate their first amendment rights. Should the U.S. Government ask EOSAT to stop distributing raw data for a few days during a crisis and EOSAT agreed; the news media might have a case against EOSAT for breach of contract, but its case against the U.S. Government for infringing its first amendment rights would be less clear.

If the media were buying their data from a foreign satellite system and the foreign government decided, for political or national security reasons, to halt or delay delivery of the data, the media would have no constitutional protections. They might, of course, be able to proceed with a breach of contract action.

The 1984 Landsat Act

Under current international law[49] and in consideration of valid concerns about the national security[50] and the public welfare,[51] there seems little doubt that the U.S. Government has the right, and indeed, the duty, to exercise its supervision over the space ventures of its citizens. In light of these serious concerns, some form of licensing and regulation is required. The question, then, is whether the specific licensing system requirement in the 1984 Landsat Act is a proper exercise of government authority.

Among its other provisions, the Landsat Act requires those seeking an operating license to "operate the system in such manner as to preserve

Box H.—Mediasat and Personal Privacy

The media's rights under the first amendment are not the only rights that a mediasat would call into question. As remote sensing satellites become more sophisticated, it is possible that the average person's expectation of privacy could be eroded. Satellites are currently capable of spotting certain crimes, such as environmental pollution. Eventually, satellites may be able to perform other law enforcement functions such as identifying and locating marijuana fields. In the far future, satellites may be able to monitor the activities of individuals.

Under current law, a person is protected against publicity given to facts of his or her private life. Although this "right of privacy" is sometimes hard to define in specific terms, it seems clear that its protections are reduced when a person appears in public.* Mediasat could alter the current understanding of what the law regards as "appearing in public." Recently, in *California v. Ciraolo* the Supreme Court decided that aerial reconnaissance was an acceptable law enforcement technique and that activities taking place in the defendant's back yard were in "plain view" even though they were surrounded by a 10 ft. high fence. Applying *Ciraolo's* logic broadly, one could argue that citizens have no right of privacy for any activity that might be seen from an airplane or by a satellite.*****

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*I. Hanson, *Libel and Related Torts,* sec. 260 (1969).

**106 S.Ct. 1809 (1986).

****Ciraolo* was a criminal law case involving a warrantless search. The case's reasoning may not be relevant to civil suits involving invasion of privacy.

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[47] 18 U.S.C. 792 to 799.

[48] Most of these statutes require that the person taking the proscribed action have "reason to believe" it would have a harmful impact. This would raise a number of difficult issues. For example, would it be a violation to include accidently a defense installation in a series of satellite photographs, or to include information that was not visible to the media but which was visible to a foreign power using sophisticated processing techniques?

[49] Outer Space Treaty, Article VI, Supra, Note 32; Some authors have suggested that a state's responsibilities under article VI are extensive:

> (W)hile no one would doubt the need for government control over space activity at its present stage, . . . Article VI would prohibit, as a matter of treaty obligation, strictly private, unregulated activity in space or on celestial bodies even at a time when such private activity becomes most commonplace. Although the terms "authorization" and "continuing supervision" are open to different interpretations, it would appear that Article VI requires a certain minimum of licensing and enforced adherence to government-imposed regulations. *Manual of Space Law*, Jasentuliyana and Lee (eds.) (Oceana Publishing, 1979), vol. 1, p. 17.

[50] A rocket that can put a payload into polar orbit can also deliver a warhead to any point on the Earth. As with other technologies on the Munitions Control List, the government has a valid interest in closely monitoring foreign access to this technology.

[51] Launch vehicles and payloads present a potentially extreme safety hazard to the citizens of this and other countries. In addition to current international law, common sense would dictate that the U.S. Government should play some role in ensuring that launch activities and payload do not cause injury.

and promote the national security of the United States."[52] Some attorneys[53] have argued that the licensing provision of the Landsat Act should be declared invalid because these provisions are neither "susceptible of objective measurement,"[54] nor drafted with the "narrow specificity,"[55] required of statutes affecting first amendment interests.

Given both the government's valid national security interest in regulating the use of launch vehicles and payloads, and the necessarily changing nature of national security concerns, it is difficult to assess how courts might respond to this argument. The references to national security in the 1984 Remote Sensing Act are certainly very general. However, a court might choose instead to focus on the specific facts of each case or on past Government actions in granting or denying licenses. The court could also decide that the regulations supporting the statute are sufficiently specific to supply both the necessary "objective measurement" and "narrow specificity."

Should a court decide that the licensing provisions of the act were not invalid on their face, then the news media might still argue that the government's use of license denials or license-imposed system limitations was unconstitutional. As discussed above, the freedom the government would have to impose restrictions would be directly related to the court's final determination of the constitutional status of news gathering activities.

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[52] 15 U.S.C. 4242(b)(1).

[53] See: Robert J. Aamoth, "From Landsat to Mediasat," *American Enterprise, the Law, and the Commercial Uses of Space* (Washington, DC: National Legal Center for the Public Interest, 1985), vol. II, p. 1.

[54] *Keyishian v. Board of Regents*, 385 U.S. 589, 604 (1967).

[55] *Hynes v. Mayor of Oradell*, 425 U.S. 610, 620 (1976).

Appendix A

The Technology of Newsgathering From Space[1]

Stillman C. Chase, Hughes Santa Barbara Research Center; and Matthew Willard, Earth Observation Satellite Co.

Introduction

Remote sensing of the Earth from space began in 1960 with the launch of the first TIROS weather satellite. The U.S. environmental satellite program has since expanded to provide low-resolution, broad-scale data from both low-Earth polar orbits and from geosynchronous orbit. These data have been widely used by the media for more than two decades to illustrate the form and motion of large-scale weather patterns.

Higher resolution multispectral images of the Earth from space first became available to the civilian user in 1972, when NASA launched the first Landsat satellite into a near-polar orbit.[2] That spacecraft carried a sensor called a multispectral scanner (MSS), which produced experimental data in four spectral bands that could be used to aid cartography; agricultural inventories; mineral, oil, and gas exploration; and land-use planning. The media have found these images of little interest primarily because the data provide a spatial resolution of only 80 meters (262 feet). Although the images generated with MSS data reveal some cultural features, including large road ways such as the interstate highways, and even large buildings, such as the Pentagon, or the shuttle assembly plant at Cape Canaveral, the identity of smaller features cannot be discerned.[3] In addition, because the first three Landsat spacecraft passed over the same longitude at the Equator only once every 18 days, and because the interval between data collection and subsequent delivery to the user (the turnaround time) could be as great as 2 months, any information they might have provided was not timely enough for media use.

In 1982 NASA launched Landsat 4, which, in addition to the MSS, carried an improved sensor, the Thematic Mapper (TM). When Landsat 4 began to fail in 1984, an identical Landsat 5 was launched. Landsats 4 and 5 are still providing data from both MSS and TM sensors, although the ability to transmit data from the TM on Landsat 4 is limited. The TM is capable of providing images of 30 meters (98 feet) resolution in seven spectral bands. The TM senses a swath 185 kilometers (115 miles) wide directly under the spacecraft. Its relatively high resolution provides images that have already proved useful for news reporting. Data are sold in the form of computer-compatible tapes or black and white or color photographs.

Each spacecraft crosses any particular longitude at the Equator only once every 16 days,[4] which means that its chance of passing over a part of the world in which a newsworthy event is taking place is low. However, because Landsats 4 and 5 are 8 days apart in their cycles, the two together can provide better coverage. For example, although the TM of Landsat 5 was able to provide an important image of the failed Chernobyl reactor, it passed above Chernobyl on April 29, 3 days after the first explosion, and could not return until Soviet technicians had extinguished the fire. In other words, it was unable to monitor the detailed progress of the fire, although it did show that the fire had been extinguished. The thermal band on the TM demonstrated that only one reactor had burned. Eight days later, Landsat 4 was able to acquire an additional image of the reactor site.

Over the years, 11 other countries (table A-1) have built data-receiving stations. Landsat 4 and 5 are capable of transmitting data directly to these foreign stations when the satellites are within range, or transmitting data to Earth via the Tracking and Data Relay Satellite System (TDRSS). Basic processing by the EOSAT Corp. corrects the data for geometric and radiometric distortions.

The Landsat system, which was originally developed and operated by NASA, was transferred to the National Oceanic and Atmospheric Administration in 1983.[5] In order to transfer land remote-sensing technology to the private sector, the Federal Government turned over operation of the Landsat system and marketing of its data to the EOSAT Corp. in December

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[1] This appendix is adapted from a paper originally prepared for the OTA workshop on Newsgathering From Space.

[2] It was then called Earth Resources Technology Satellite (ERTS).

[3] Objects just below the limit of resolution, generally can be discerned as objects on the images, but their identity generally cannot.

[4] Because the Landsat orbit is a polar orbit, it can "revisit" areas north of the Equator more often. The exact number of days between overhead passes varies according to latitude.

[5] NOAA assumed operational responsibility for the TM sensor in 1984.

Table A-1.—Foreign Landsat Ground Stations

Actively receiving data (MOU signed with NOAA):
Australia
Brazil
Canada
European Space Agency (Sweden, Italy)
India
Japan
Thailand
Peoples Republic of China
Saudi Arabia
South Africa

Not presently receiving data:
Argentina
Pakistan (under construction)
Indonesia (no signed agreement)
Bangladesh (no signed agreement)

SOURCE: National Oceanic and Atmospheric Administration.

1985.[6] In return for a government subsidy of $250 million,[7] EOSAT was to build and operate Landsat 6 and 7. However, because EOSAT has received only part of the agreed-upon subsidy, it has been forced to stop construction of Landsat 6. The future of civilian land remote sensing in the United States is in serious doubt.[8]

In February 1986, France successfully launched its own system, called the Systeme Probatoire d'Observation de la Terre (SPOT). SPOT provides 20 meter data in three spectral bands, as well as 10 meter panchromatic (black and white) imagery of Earth's surface. Although the SPOT satellite recrosses the same longitude only once every 26 days, its sensor is capable of viewing at an angle, or off-nadir, making it possible to gather images from a particular surface area 7 out of 26 days.[9]

A Mediasat System

Although attention generally focuses on the sensors and their capabilities, the imaging instrument itself would be a small component of an overall satellite system capable of providing the data for media use. A remote-sensing satellite system consists of four major tasks, each of which is critical to producing useful images:

1. data acquisition—the spacecraft, sensors, and transmitters;
2. data collection and delivery—the receiving station and other communication components; and
3. initial image processing; and
4. interpretative analysis.

In addition, a launch vehicle is required to place the spacecraft in orbit.[10]

Media proponents of using remotely sensed data have suggested the following key requirements:

- high spatial resolution (5 meters or less);
- sensors operating in at least three spectral bands, or colors;
- frequent revisit of each area (1 to 2 days);
- relatively narrow field of view (10 to 15 miles); and
- quick delivery time to the media (24 hours or less).

For purposes of discussion, OTA has selected a baseline system capable of 5 meters resolution that would satisfy most of the conditions the media say they need for a mediasat (table A-2 and table A-3). For comparison, OTA also selected a less capable, but less costly minimum system capable of 10 meters resolution that could serve the interim needs of the media (table A-4). The sensor and associated electronics of the second, less capable system might be carried as an auxiliary package on a large spacecraft similar to the Omnistar satellite proposed by EOSAT. This step would allow news agencies to gain experience with using remotely sensed data in preparation for constructing a much more capable, but more costly, baseline system.

Table A-2.—Moderate and High-Performance Concepts Drive Sensor Cost

Concept	Minimum	Baseline
Pushbroom optics	Refractive	Reflective
Focal length/f-number	60 cm; f/4	212 cm; f/6
Resolution at nadir	10m	5m
Number detectors and spacing	512, 7 μm	5,120, 15 μm
Swath width at nadir	5 km	25 km
Pointing mechanics	One axis gimbel	One axis gimbel
System power/data rate	10-30W/ 8.3 Mbps	50-100W/ 166 Mbps
Sensor size (1×W×H)	30″×30″×30″	60″×30″×30″
Sensor weight	<100 lbs	~500 lbs
Sensor cost	$5-10 million	$60-80 million

SOURCE: Hughes Corp., Santa Barbara Research Center.

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[6] See U.S. Congress, Office of Technology Assessment, *Land Remote Sensing and the Private Sector: Issues for Discussion* (Washington, DC: U.S. Government Printing Office, March 1984, for an extensive discussion of the history behind transfer of the Landsat system to the private sector. See also *International Cooperation and Competition in Civilian Space Activities* (Washington, DC: U.S. Government Printing Office, July 1985; and U.S. Congress, "The Commercialization of Meteorological and Land Remote-Sensing Satellites," Hearings before the Subcommittee on Natural Resources, Agriculture Research and Environment and the Subcommittee on Space Science and Applications of the House of Representatives Committee on Science and Technology, 1983 [No. 53].

[7] Not including launch costs, which were estimated to be $50 million to $70 million.

[8] Theresa M. Foley, "Reagan Asked to Intercede To Save Landsat Program," *Aviation Week and Space Technology*, Apr. 6, 1987, pp. 29-30.

[9] Note that viewing objects at an angle causes the resolution to decrease. In addition, objects in the shadow of tall structures will generally not be visible.

[10] Until at least 1990, the ability of the United States to launch payloads will be severely constrained. The first flight of the refurbished shuttle may not take place before late 1988. In addition, because building an expendable launch vehicle takes 2 years or more, even if a launcher were ordered in May 1987, it would not be ready until mid to late 1989.

Table A-3.—Estimates of Baseline Mediasat System Costs[a]

Component	One satellite system	Two satellite system
Sensor	$60-80 million	$100-140 million
Launch	$35-50 million	$70-100 million
Spacecraft	$40-50 million	$70-90 million
Data collection (TDRS with dual tape recorders)	$40-50 million	$70-90 million
Ground segment (data capture facility, image processing, spacecraft management and control)	$40-50 million	$40-50 million
Total	$215-280 million	$350-470 million

[a] These are rough estimates, based on general knowledge of what such systems might cost. They are not based on a particular engineering design. Estimates do not include insurance or operating costs.

SOURCE: Office of Technology Assessment, 1987.

Table A-4.—Estimates of Low-Cost, Minimum Mediasat System Costs[a]

Component	One satellite system	Two satellite system
Sensor	$5-$10 million	$10-$15 million
Launch	Not applicable	
Spacecraft (incremental marginal costs)	$2 million	$4 million
Data collection (incremental marginal costs)	$2 million	$3 million
Ground segment (image processing)	$10-$20 million	$10-$20 million
Total	$19-$34 million	$27-$42 million

[a] This concept assumes that the sensor(s) would fly as an additional sensor on a remote sensing satellite. It also assumes that a dedicated ground system would be necessary to process data in a timely manner. These are only rough estimates, based on general knowledge of what such systems might cost. They are not based on a particular engineering design. Cost estimates do not include insurance or operating costs.

SOURCE: Office of Technology Assessment, 1987.

Data Acquisition

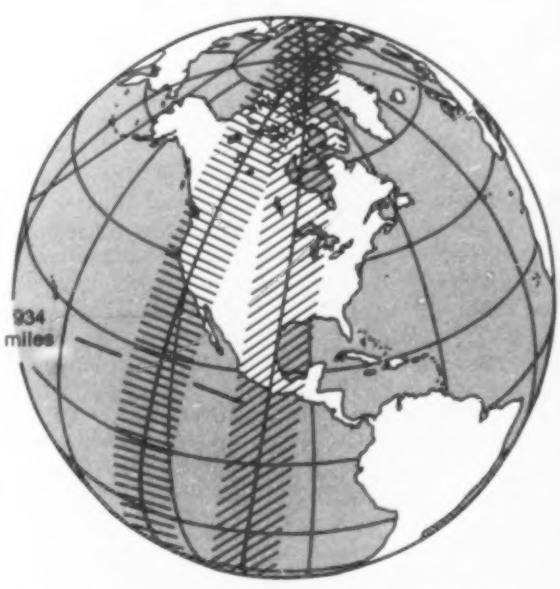
The Spacecraft.—A relatively small three-axis stabilized spacecraft, equivalent in capability to the spacecraft used for the polar-orbiting TIROS environmental spacecraft, could serve the needs of a mediasat. It would be flown in a near-polar, Sun-synchronous orbit having Equator crossing times in the morning when shadows are generally strong to provide good image definition. To achieve daily coverage, two spacecraft would be flown.

Sensor Design.—High spatial resolution is the principal performance requirement for a mediasat. Neither a conventional television camera nor a specialized high-resolution (875 or 1,200 line) camera are capable of serving as the mediasat sensors, even when fitted with adequate optics, primarily because they are not sensitive enough and lack the appropriate field of view. A mediasat would require specialized sensors and optics similar to those being developed for the next generation Landsat or SPOT systems (so-called multispectral linear arrays). The sensor itself would be simpler to build and cheaper than the TM, as it would have no rapid scanning or cooled detectors.

For purposes of illustration, OTA has selected a goal of 5 meters spatial resolution at the nadir. This represents a factor of 6 improvement (or a factor of 36 in areal resolution) over the resolution of the TM, or a factor of 2 (4 in areal resolution) over SPOT. However, in order to revisit a spot on Earth within 2 days of overflight, the sensor must have the capacity to point off-nadir by at least 45 degrees (figure A-1).[11] Therefore, the sensor chosen in this design would be capa-

Figure A-1.—Mediasat Two-Day Repeat Coverage With One Satellite

Earth coverage at ± 45° from 705 km orbit



- Footprint is 5 m (16.4 ft) at nadir, 12.2 m (40 ft) at edge of field (45°)
- Swath is 25 km (15.5 miles) at nadir, 60 km (37.3 miles) at edge of field

SOURCE: Hughes, Santa Barbara Research Center.

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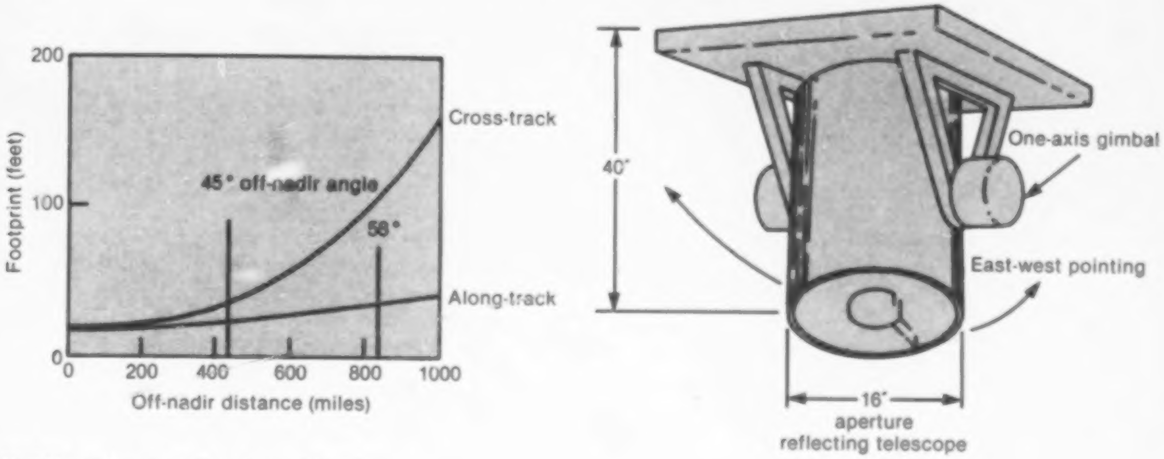
[11] By increasing the off-nadir pointing angle to 58 degrees, it is possible to achieve one-day revisit capability. However, the resolution of the image would be degraded to a rather large 34 meters. In addition, the haze and obliquity of the viewing angle would further degrade the image and reduce the photo-interpreter's ability to delineate details.

Figure A-2.—The Baseline System Has High Performance

- Image footprint grows with off-nadir view



SOURCE: Hughes, Santa Barbara Research Center.

ble of resolutions from 5 to 13 meters in off-nadir viewing (figure A-2). At high latitudes, this design would allow daily coverage, because the ground tracks of the sensor would overlap from day to day (figure A-2 and figure A-3)

The choice of sensor resolution constitutes a critical design compromise, for the costs of bettering the resolution increase at a nonlinear rate. A system achieving 5 meters resolution at 45 degrees off-nadir would have to be capable of reaching nearly 2 meters resolution at the nadir. However, the costs of providing a system capable of resolving objects as small as 2 meters are much greater than five-halves of the cost of a 5 meter system, because improvements in the resolution or sensitivity of the sensors would also require substantial improvements in the other parts of the system such as the data transmission components (see below). Overall costs of the system therefore are extremely sensitive to the capability of the sensors.

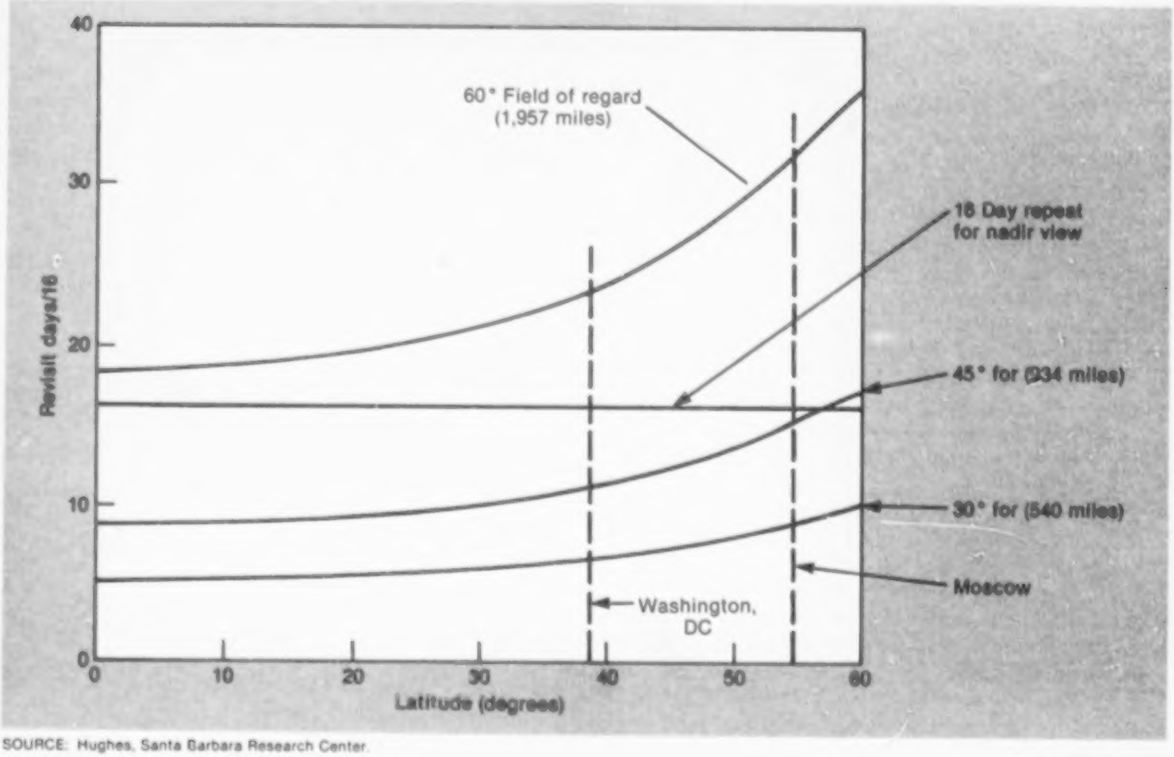
For television use, and for additional analytical capacity, the media requires sensors capable of producing images in three spectral channels in order to present a color image to the public. In addition, the sensor would provide a panchromatic (black and white) band having the same resolution but higher sensitivity in order to sense the Earth at low light level. A 25-km by 25-km instantaneous field of view (approximately a 15-mile by 15-mile image) would provide approximately 10 television screens of data in each satellite image.

Spacecraft Management and Control.—Either at the receiving station, the image processing facility, or some other location, a facility would have to be built to communicate with the satellite. This station would support the receiving facility, overall mission management and spacecraft scheduling, including sending commands to the spacecraft, as well as monitoring spacecraft health and status. A facility of this sort could cost on the order of $20 million to $30 million.

Data Collection and Delivery

Rapid data delivery from the spacecraft to the media (approximately 6 to 8 hours) is essential for timely media use. The collection and delivery system is composed of two major components: transmission to a receiving facility; and delivery to the processing facility.

Transmission From the Spacecraft.—The transmission components of the spacecraft would consist of a sophisticated special-purpose computer for organizing the sensed data, a transmitter, and pointable antennas for transmitting data to a communication satellite or directly to Earth. Here again, the costs of a remote-sensing system increase much faster than the increase in resolution. In particular, costs could increase by as much as the inverse square of the resolution because, as the pixel size decreases, the number of pixels in an area increase by the square of the change in pixel size. Thus, halving the size of the resolution element quadruples the number of pixels in the image. Improving the resolution to 5 meters (and reducing the area covered in each image frame) could lead to transmission data rates of 100 to 150 megabits per second (Mbps). For comparison, the current TM data rate is 85 Mbps, Figure A-3.—Mediasat Revisit Time Improves at Higher Latitudes



SOURCE: Hughes, Santa Barbara Research Center.

and the SPOT sensors approximately 50 Mbps. However, data compression techniques used on the spacecraft could reduce the data rate well below 100 Mbps.

Data Collection.—Remote-sensing systems have used three different methods for collecting global imagery from polar-orbiting satellites:

1. a system of ground stations spread around the world,
2. the NASA Tracking and Data Relay Satellite (TDRS), or
3. tape recorders onboard the satellite to store data until they can be transmitted to a single Earth receiving station located on home territory.

A Worldwide System of Earth Receiving Stations.—In developing the Landsat system, the United States encouraged other nations to build and operate their own data-receiving stations (table A-1). In part this was an attempt to spread the use of remotely sensed data to countries where conventional map and aerial photographic techniques were limited. These stations have also supplemented the acquisition of data from the Landsat series of satellites, which have either carried tape recorders or a TDRS transmitter. For a fee, EOSAT transmits data from the Landsat satellite as it passes within range. In return, these stations are licensed to sell data to customers, but must provide it on the same nondiscriminatory basis as EOSAT. However, because these stations are under the control of foreign governments, in practice customers have sometimes experienced considerable delays in receiving requested data.[12] This fact, and the considerable cost inherent in receiving timely data from a scattered set of receiving stations, make this option infeasible for a mediasat system.

The Tracking and Data Relay Satellite.—TDRS consists of two or three satellites in geosynchronous orbit and a single Earth receiving station. The TDRS relays data from the remote-sensing spacecraft to NASA's TDRS reception facility at White Sands, New Mexico. From there the data can be re-transmitted via a domestic communications link to a processing center. Using a system like TDRS allows a remote-sensing satellite to avoid reliance on onboard tape recorders or foreign ground receiving systems. EOSAT currently uses the TDRS system on a limited basis for collecting Landsat data of areas outside of the footprint of EOSAT's data capture facility at the Goddard Space Flight Center.

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[12] Interviews with NOAA officials, 1985; Workshop paper by Peter Fend, Ocean Earth Corp., 1986.

Use of TDRS has several major drawbacks. First, the annual cost for this service varies according to the volume of data transmitted, and could reach $5 to $6 million per year. In addition, using the TDRS system requires adding a TDRS communication package to the spacecraft at a cost of approximately $25 million.

Second, because only one TDRS is currently operating, imagery cannot be relayed from the Far East or Pacific Basin. A second TDRS is on the manifest of the first shuttle scheduled to fly after shuttle flights are resumed.[13] This will provide global coverage except in a narrow zone of exclusion over India. However, the currently operating TDRS has developed technical problems that may shorten its lifetime.

The third, and potentially most serious, drawback is that because TDRS was developed primarily to serve NASA and DOD missions, it operates on a priority basis. Many of the system users have much higher priority than a private sector corporation would have. Thus, during flights of the space shuttle and some DOD space missions, the media might have little or no access to TDRS.

Tape Recorders.—Tape recorders can be used to store data on the spacecraft until they can be transmitted to Earth. A space-rated tape recorder of the necessary data capacity currently costs about $5 million. A fully redundant system would require three tape recorders per satellite. Each tape recorder weighs about 150 pounds, and therefore also substantially increases the weight of a spacecraft.

A receiving station is most effective when located at a northern latitude so the data capture facility is within transmission range of the satellite more often. For instance, the receiving station EOSAT plans to build in Norman, Oklahoma, will "see" about 34 minutes of data per day. A facility in Fairbanks, Alaska, would "see" approximately 80 minutes of data per day and therefore be able to receive substantially more data, more frequently. A data-receiving station might cost as much as $10 million.

A tape recorder system would be completely self-sufficient and the capital and operating costs would be quite a bit less without the cost of the TDRS communication package. However, space-rated tape recorders capable of high data rates have proved unreliable in the past and have failed, or suffered operational limitations, before the sensors failed. Moreover, in some instances there would be delays in transmitting data to the media, depending on the area of interest being imaged and the time at which the satellite next comes in view of the receiving station. Even at northern latitudes, for example, delays in transmitting data to the receiving facility could be as much as 5 to 6 hours. Generally, most of these time delays would be tolerable.

Delivery to the Image Processing Facility.—Once collected, the data must be re-transmitted to the mediasat data processing facility where the raw data could be transformed into usable images for television and newspapers. Because the data would need to be transmitted quickly for media use, it is likely that they would be sent via a domestic communication satellite. A dedicated transponder for this purpose would cost about $2 million per year.

Image Processing

The cost and complexity of the processing system depends on a variety of factors, including data rate, the number of scenes to be processed per day, and the speed with which data would need to be turned into images usable by the media. These and other desired data processing requirements must be considered before a detailed cost estimate of the image processing facility can be made. A fully operational ground processing facility might cost on the order of $10 to $15 million.

Image Interpretation

Obtaining the image is only the first step in the process of making use of imagery from space. The images are often of very little use until they are integrated with other data, enhanced, and analyzed by expert photo-interpreters. For example, computer processing may make it possible to improve the image's resolution, or to analyze one of the color bands for particular information. In the civilian realm the need for such expertise in oil, gas, and minerals exploration; crop assessment; land planning; map making; or archaeological research[14] has encouraged the development of an industry (the so-called value-added industry) to make the data more useful. The media will have to rely on experts from the value-added industry to interpret mediasat images for the public.

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[13] The first shuttle flight is scheduled to occur in spring 1988, but may be delayed until late 1988 or possibly early 1989.

[14] U.S. Congress, Office of Technology Assessment, *Technologies for Prehistoric and Historic Preservation*, OTA-E-319 (Washington, DC: U.S. Government Printing Office, September 1986).

Appendix B

Media Access to and Use of Remote Sensing Data: A Legal Overview[*]

Rita Reimer, Congressional Research Service

The Constitutional Status of Newsgathering

Although the Supreme Court stated in *Branzburg* v. *Hayes*, a 1972 journalists' privilege case, that "[it is not] suggested that news gathering does not qualify for first amendment protection; without some protection for seeking out the news, freedom of the press could be eviscerated[,]"[1] the Court has not yet decided whether newsgathering activities receive the same constitutional protection as traditional speaking and publishing activities. The only Supreme Court cases that address this issue *per se* involve media access to prison inmates, and thus are not directly analogous to a mediasat.

In two 1971 companion cases, *Pell* v. *Procunier*[2] and *Saxbe* v. *Washington Post Co.*,[3] the Court rejected arguments that the first amendment guaranteed the press the right to interview individual prisoners. (The press had argued that they had a constitutional right to interview any willing inmate, which could only be abridged if prison authorities made an individualized determination that interviewing a particular inmate would constitute a clear and present danger to prison security or another substantial interest of the prison system.)

This decision was affirmed 4 years later, in *Houchins* v. *KQED*,[4] a 3-1-3 decision that indicated that the press should at times be given preferential treatment, including under the circumstances presented in that case (where television station KQED sought access to a local jail to document allegedly unsafe and unhealthy conditions).

The *Pell* v. *Procunier* Court cited with approval the following statement from *Zemel* v. *Rusk*,[5] a 1965 case that upheld the right of the State Department to refuse to issue passports for travel to Cuba under specified circumstances:

> There are few restrictions on action which could not be clothed by ingenious argument in the garb of decreased information flow. For example, the prohibition of unauthorized entry into the White House diminishes the citizen's opportunities to gather information he might find relevant to his opinion of the way the country is being run, but that does not make entry into the White House a First Amendment right. The right to speak and publish does not carry with it the unrestrained right to gather information.

Again, none of these cases are analogous to a mediasat situation where various companies and organizations are likely to launch such satellites or attempt to utilize government civilian satellites on a space-available basis. Denying the press access to such activities would seem clearly to run counter to these cases.

U.S. restrictions on newsgathering are less likely if the U.S. media should choose to buy its data from foreign remote sensing systems such as the French SPOT. Here the issue is not the constitutionality of such attempts but rather their practicality. In the absence of an intergovernmental agreement, U.S. laws could not be used to influence the data acquisition practices of foreign governments.

A more difficult problem is presented in attempting to determine what restrictions could properly be placed on use of the information that is so acquired.

The Doctrine of Prior Restraint

The doctrine of "prior restraint" holds that, except in extraordinary situations, any procedure used to suppress protected speech must rely on a post-publication sanction rather than on a pre-publication restriction. The leading case in point is *Near* v. *Minnesota*,[6] a 1931 decision that struck down an injunction barring publication of a local newspaper, which had been adjudged a public nuisance because it had printed allegedly defamatory articles about some public officials.

In *Near* v. *Minnesota*, the Supreme Court stated, "No one would question but that a government might prevent actual obstruction to its recruiting service or the publication of the sailing dates of transports or the number and location of troops."[7]

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[*] This appendix is adapted from a paper originally prepared by the Congressional Research Service for the Subcommittee on Space Science and Applications of the House Committee on Science, Space, and Technology. The complete version of this paper also served as a background paper for the OTA workshop on Newsgathering From Space.

[1] 408 U.S. 665, 681 (1972). The decision required certain journalists to testify before grand juries about people to whom they had promised confidentiality while investigating alleged criminal activities which were the subject of subsequent news articles.

[2] 417 U.S. 817 (1974).

[3] 417 U.S. 843 (1974).

[4] 438 U.S. 1 (1978).

[5] 381 U.S. 1, 16-17 (1985), cited at 417 U.S. 834.

[6] 283 U.S. 697 (1931).

The concern most frequently expressed in connection with potential mediasat activities involves national security. One commentator has summarized SPOT's potential in this context as follows:

> If Iraq says it attacked a port in Iran, but Iran denies it, satellite imagery could resolve the dispute. What does the closed Soviet city of Gorki look like, or Kharq Island or the hijacked Achille Lauro cruise ship? Did an Afghan village really burn down? Satellite imagery could provide the answers . . . The next time a Grenada erupts, it may matter less that reporters and cameramen are not invited along; the spacecam will have it covered.[8]

Perhaps the most famous prior restraint case is that involving the so-called "Pentagon Papers," a 1971 Supreme Court decision, *New York Times Co.* v. *United States*.[9] The "Pentagon Papers" came from a classified 47-volume Pentagon study, officially entitled "History of U.S. Decision Making Process on Vietnam Policy," which described the origins of United States' involvement in the Vietnam war. The material had already been widely circulated and all of it was at least 3 years old. The government originally sought to have publication curtailed under Section 793 of the Espionage Act;[10] but when this statute was held inapplicable, they also argued that "inherent [constitutional] powers" to safeguard national security entitled them to an injunction prohibiting publication. However, their arguments were rejected in a 6-3 decision. The ruling itself is a brief *per curiam* decision but each Justice elaborated on his views in a separate concurring or dissenting opinion. Of the six concurring opinions, Justices Black and Douglas, both of whom held an absolutist view of the first amendment,[11] each stated that in his view prior restraints were never permissible. Justice Brennan thought that prior restraint was permissible to the extent described in *Near* v. *Minnesota*, but added that "the First Amendment tolerates absolutely no prior judicial restraints of the press predicated upon surmise or conjecture that untoward consequences may result."[12] Justice Stewart, joined by Justice White, stated that, in the absence of applicable statutes, he would permit prior restraints ~~on~~ publication only if necessary to prevent "direct, immediate, and irreparable damage to our Nation or its people."[13] Finally, Justice Marshall found prior restraint inappropriate in this case because it had not been authorized by Congress.

The only case that upheld a prior restraint in this context is a 1979 decision by the United States District Court for the Western District of Wisconsin, *United States* v. *The Progressive, Inc.*[14] In that case an injunction was issued against a magazine which was planning to publish an article that contained a detailed discussion of hydrogen bomb technology.

The *Progressive* court relied primarily on the Pentagon Papers case, noting that several of the majority Justices in that decision had indicated that they might be more favorably inclined toward the government's position if there was a specific statute, that is, a congressional enactment, that barred the challenged publication. The court noted that there was such a statute in the *Progressive* case, 42 U.S.C. Section 2274. The court also indicated that in its view the government had met the standard laid down in the Pentagon Papers case by Justices Stewart and White, in that the publication would result in "grave, direct, immediate and irreparable harm to the United States."[15]

When the United States invaded Grenada in 1983, the government imposed a total news blackout on the operation. Media representatives were prohibited from accompanying the invasion forces in the initial landings on the island and members of the press who attempted to travel independently to the island were prevented from reporting news of the invasion. The ban was lifted some days later, after the island had been secured and most of the fighting had ended.

The press subsequently challenged the ban and sought a permanent injunction against any future such ban. However, the challenge was dismissed as moot by the United States District Court for the District of Columbia,[16] which held that the plaintiffs had not shown that they personally faced a specific, imminent threat of irreparable harm, as required before the conduct of vital governmental functions, requiring the exercise of discretion in a myriad of unpredictable circumstances, will be enjoined. The court explained:

> The invasion of Grenada was, like any invasion or military intervention, a unique event. Its occurrence required a combination of geopolitical circumstances not likely to be repeated. In addition, it required a discretionary decision by the President of the United States as Commander-in-Chief to commit United States forces. The decision to impose a temporary press ban was also a discretionary one. It was made by the military commander in the field of operations because the

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[7] 283 U.S. at 716 (footnote omitted).

[8] Mauro, "The Puzzling Problems of Pictures From Space," *Washington Journalism Review* (June 1986):15.

[9] 403 U.S 713 (1971).

[10] 18 U.S.C. Sec. 793(e).

[11] The first amendment in pertinent part provides, "Congress shall make no law abridging freedom of speech, or of the ~~press~~." Justices Black and Douglas interpreted this language [*no* law] literally and thus consistently voted against any press restrictions.

[12] 403 U.S. at 725-26.

[13] *Id.* at 730.

[14] 467 F. Supp. 990 (W.D. Wis.), *dismissed mem* 610 F.2d 819 (7th Cir. 1979).

[15] 467 F.Supp. at 996.

[16] *Flynt v. Weinberger*, 588 F.Supp. 57 (D.D.C. 1984).

> safety of press representatives could not be guaranteed and in order to ensure that secrecy was maintained, thereby protecting the safety of United States troops and promoting the success of the military operation.[17]

The court also stated that a permanent injunction against future press bans of this nature "would limit the range of options available to the commanders in the field in the future, possibly jeopardizing the success of military operations and the lives of military personnel and thereby gravely damaging the national interest."[18]

It is likely that future cases of this nature, including those involving images from space, would be resolved on a case-by-case basis under reasoning comparable to that set forth in the district court's decision in *Flynt* v. *Weinberger*.

No special rules would be needed to govern the use of imagery obtained from foreign satellites. Attempts to limit the media's use of such imagery would be subject to the same consitutional scrutiny as attempts to limit imagery obtained from U.S. satellites. Material of a foreign origin which was aired or printed in the United States would, however, be subject to the same constitutional and other restrictions as would material of a U.S. origin. For example, attempts to limit its publication would be subject to the rules on "prior restraint." Similarly, the dissemination of such information could serve as the basis for a defamation suit in the United States. Most important, it could violate various national security laws if sensitive information were disclosed.

The Land Remote-Sensing Commercialization Act of 1984, its legislative history, and the proposed regulations intended to implement it[19] all speak to national security concerns in general terms and thus provide little guidance as to how particular matters would be handled. For example, the Act's congressional findings state that "land remote sensing by the Government or private parties of the United States affects international commitments and policies and national security concerns of the United States;"[20] and its declaration of purposes notes that a purpose of the law is to "maintain the United States' worldwide leadership in civil remote sensing, preserve its national security, and fulfill its international obligations."[21] Those seeking a license to operate private remote-sensing space systems must agree to "operate the system in such manner as to preserve and promote the national security of the United States."[22]

The proposed regulations similarly require applicants to submit "adequate operational information regarding the applicant's remote-sensing space system on which to base review to ensure compliance with national security and international requirements."[23] The accompaning commentary states that the National Environmental Satellite, Data, and Information Service (NESDIS) recognizes that some prospective applicants may want greater certainty as to when a license might be denied or conditions imposed to protect national security or foreign policy interests, but explains that this is not feasible because "individual judgments [will be] made in a context affected by rapidly changing technology and [therefore] must be made on a case-by-case basis."[24] The EOSAT contract similarly provides that the company will comply with all national security requirements.[25]

The Secretary of Commerce is to consult with the Secretary of Defense on all matters arising under the Land Remote-Sensing Commercialization Act that affect national security,[26] and with the Secretary of State on all such matters that affect international obligations.[27] Those secretaries are responsible for determining which conditions come within their respective areas of concern, and notifying the Secretary of Commerce promptly of any such conditions. Again, no specific information is provided to limit or clarify precisely what is covered by this broad language.

In sum, it appears that the standard of "grave, direct, and irreparable harm to the United States" as cited in the Pentagon Papers and *Progressive* cases would be utilized in deciding whether pre-publication restraints were appropriate with regard to Landsat-generated materials. Because the government and the press are likely to disagree about when this possibility exists, judicial intervention would seem necessary to determine what, if any, restraints could appropriately be applied to particular sets of circumstances as they arise.

Subsequent Sanctions

The fact that material can constitutionally be broadcast or printed does not mean that those responsible cannot subsequently be sanctioned for that action. Several Federal laws could be applied to the publication or other release of classified information, depending on its content, even where the doctrine of prior restraint precluded the government from prohibiting its dissemination.

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[17] *Id.* at 59.

[18] *Id.* at 60.

[19] 51 *Fed. Reg.* 9971 (Mar. 24, 1986).

[20] 15 U.S.C. Sec. 4201(4).

[21] 15 U.S.C. Sec. 4202(b).

[22] 15 U.S.C. Sec. 4242(b)(1).

[23] Proposed 15 CFR Sec. 960.6. Specific technical information and marketing plans for the data received, must be included to help the licensing agency make its determination.

[24] 51 *Fed. Reg.* 9972 (Mar. 24, 1986).

[25] EOSAT hearing, *supra* n. 10, at 58. (The text of the contract is not provided).

[26] 15 U.S.C. Sec. 4277(a).

[27] 15 U.S.C. Sec. 4277(b).

Federal espionage laws are codified at chapter 37 of the Federal criminal code.[28] Specific prohibitions include gathering, transmitting or losing defense information;[29] gathering or delivering defense information to aid a foreign government;[30] photographing defense installations;[31] using aircraft for photographing defense installations;[32] publishing or selling photographs of defense installations;[33] and the disclosure of classified information.[34] Most of these statutes do not require a specific intent to injure the United States, but only that the person taking the proscribed action have "reason to believe" it will have a harmful impact.

Several Justices writing in the Pentagon Papers case indicated that these laws could be invoked against those who published classified material; see, for example, the following statement from Justice White's concurring opinion:

> The Criminal Code contains numerous provisions potentially relevant to these cases. Section 797 makes it a crime to publish certain photographs or drawings of military installations. Section 798, also in precise language, proscribes knowing and willful publication of any classified information concerning the cryptographic systems or communication intelligence activities of the United States as well as any information obtained from communication intelligence operations. If any of the material here at issue is of this nature, the newspapers are presumably now on full notice of the position of the United States and must face the consequences if they publish. I would have no difficulty in sustaining convictions under these sections on facts that would not justify the intervention of equity and the imposition of a prior restraint.[35]

Justice Marshall similarly expressed the view that prosecutions under these laws would be acceptable if publications were found to have violated their prohibitions.[36] Even Justice Douglas, well known for his opposition to any press restrictions, indicated that he might be persuaded to apply Federal espionage laws to the press under carefully drawn circumstances, as when war had been declared pursuant to a declaration of war (Vietnam was an undeclared war).[37] The three dissenting Justices (Chief Justice Burger, Justice Harlan and Justice Blackmun) supported the imposition of a prior restraint in this case, so they presumably would also have supported post-publication sanctions against those who published the challenged material.

Other Federal laws that might encompass certain land remote-sensing activities include 50 U.S.C. Section 783, which prohibits the communication of classified information by a government officer or employee, or the receipt of classified information by a foreign agent or a member of a Communist organization; and 42 U.S.C. Section 2274, the statute utilized in the *Progressive* case, a provision of the Atomic Energy Act which prohibits the communication of restricted data which may be utilized to injure the United States or to secure an advantage to any foreign nation.

On the other hand, it is difficult to generalize as to how these laws would apply to particular Landsat activities. For example, the prohibition on gathering or transmitting defense information applies to "whoever, for the purpose of obtaining information respecting the national defense with intent or reason to believe that the information is to be used to the injury of the United States, or to the advantage of any foreign nation," takes any proscribed action.[38] Those presenting satellite-generated material could argue that their intent was not to gather or transmit defense information, or that they had no reason to believe that it would be used to harm the United States. On the other hand, some prohibitions would seem clearly to apply to these activities, such as those against photographing defense installations,[39] and publishing or selling photographs of such installations.[40] Even here, however, some questions would likely remain. For example, would the incidental inclusion of a defense facility in a series of satellite photographs encompassing many images come within the purview of these prohibitions? What if the system operator lacked the sophistication to identify the prohibited image, but a purchaser using more advanced techniques was able to do so? It is simply impossible to answer such questions at this time.

Material generated by remote sensing activities which is broadcast or published is subject to the same restrictions as is similar material which comes from more conventional sources. For example, to the extent that it is obscene or defamatory, it can be challenged on those grounds. However, as technology becomes more advanced, a potential problem involving the right of personal privacy could develop—if it has not already.

A person who appears in public ordinarily waives his or her right to privacy, as long as the resulting photographs or commentary are accurate.[41] Aerial reconnaissance is an accepted law enforcement technique, most recently affirmed by the Supreme Court in a 1986 decision *California* v. *Ciraolo*.[42] On the other hand, a person is protected against publicity given concerning facts of his or her private life.[43] If, in fact, land remote-sensing satellites were capable of determining which newspaper a person is reading in his or her backyard, the potential for invasion of privacy would seem to be quite high. Again, this possibility would not serve as the basis for prohibiting printing or broadcasting such material, but such dissemination could lead to later lawsuits by those who felt their privacy had been invaded.

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[28] 18 U.S.C. Sects. 792 to 799.

[29] 18 U.S.C. Sect. 793.

[30] 18 U.S.C. Sect. 794.

[31] 18 U.S.C. Sect. 795.

[32] 18 U.S.C. Sect. 796.

[33] 18 U.S.C. Sect. 797.

[34] 18 U.S.C. Sect. 798.

[35] 403 U.S. at 735-37 (White, J., concurring)(footnotes omitted).

[36] *Id.* at 745 (Marshall, J., concurring).

[37] *Id.* at 720-22 (Douglas, J., concurring).

[38] 18 U.S.C. Sec. 793(a).

[39] 18 U.S.C. Sec. 795.

[40] 18 U.S.C. Sec. 797.

[41] I. Hanson, *Libel and Related Torts*, Sec. 260 (1969). An action will lie if a misleading impression is given, however, as in the case of an innocent child whose picture is used to illustrate an article on juvenile delinquents. *Metzger v. Dell Publishing Co.*, 207 Misc. 182, 136 N.Y.S. 2d 888 (Sup. 1955).

International Considerations

At the international level, the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies [Outer Space Treaty],[44] which was signed in 1967, declares that space "shall be free for exploration and use by all States," and that it "is not subject to national appropriation." Although states have not agreed on the definition of where outer space begins,[45] they have agreed that civilian land remote-sensing satellites operate in outer space and not within the boundaries of any country.

While all countries have laws against espionage, there is no rule or principle of international law that prohibits a nation from observing activity within another nation from beyond that country's territory.[46] Indeed, the United States has consistently adhered to an "open skies" policy, which states that no nation has the right to control or prevent remote-sensing of its own territory. This does not mean that no legal questions exist with regard to the practice of remote sensing from space.

In 1971, the United Nations' Committee on the Peaceful Uses of Outer Space [COPUOS] established a working group on remote sensing to develop a set of rules governing the operation of these systems. In 1987, COPUOS agreed on a set of 15 principles that would serve as voluntary guidelines for national remote sensing activities.[47] Although no requirement that prior consent be obtained before one country could survey another's resources is included, the guidelines promote international cooperation and access to data on a nondiscriminatory basis.[48] Interestingly, much of the concern in this area has arisen not in the United States or the Soviet Union, but among lesser developed countries who fear that they will be at an unending disadvantage if their needs and desires are not taken into account at this relatively early stage of the planning process.[49] While it is likely that over time a consensus will be reached as to some of these issues, national self-interest may make this a long and drawn-out process, one in which the end results remain uncertain. Major deviations from the present practice could, of course, affect the media's ability to access and report on certain items generated by use of this technology.

Conclusion

There is apparent agreement on the usefulness of land remote-sensing techniques in gathering a wide range of information, where such gathering and dissemination is not likely to be challenged (primarily environmental and geological data). Questions arise when the material so gathered can be seen as a threat to national security, personal privacy, or other protected interests.

At this time it appears that courts would likely uphold the right of the media to operate and/or utilize land remote sensing satellites, and the media would be allowed to broadcast or print any information which was so obtained unless a pre-publication restriction was justified to prevent direct, immediate, and irreparable damage to the United States or its citizens (the standard employed in the Pentagon Papers case). However, the media could subsequently be penalized for releasing information found to violate national security or other pertinent statutes.

At the international level, there is currently no restriction on observing and photographing a country from outside its borders, including by satellite, from space. However, future international agreements may limit somewhat the complete freedom which is currently enjoyed in this context.[50]

This entire situation involves a rapidly evolving technology, which is sought to be handled by a much more slowly evolving state of the law. As such, it will likely remain unsettled for the foreseeable future.

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[42] 54 U.S.L.W. 4471 (1986).

[43] I. Hanson, *supra* n. 15, Sec. 252.

[44] Jan. 27, 1967, 18 U.S.T. 2410, T.I.A.S. No. 6347, 610 U.N.T.S. 205.

[45] Note, "Explorations in Space Law: An Examination of the Legal Issues Raised by Geostationary, Remote Sensing, and Direct Broadcase Satellites," *N. Y. L. Sch. L. Rev.* 19(1985):724.

[46] *Id.* at 723-24.

[47] "Principles relating to remote sensing of the Earth From Space," United Nations General Assembly A/RES/41/65, 22 January 1987.

[48] Principles XII and XIII.

[49] Stewart, "The New World Information and Communication Order in Light of U.S. Media Practice," 16 *New York University, J. International & Pol.* 635 (1984).

[50] Note, "Explorations in Space Law," *supra* n. 45 (entire article).

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